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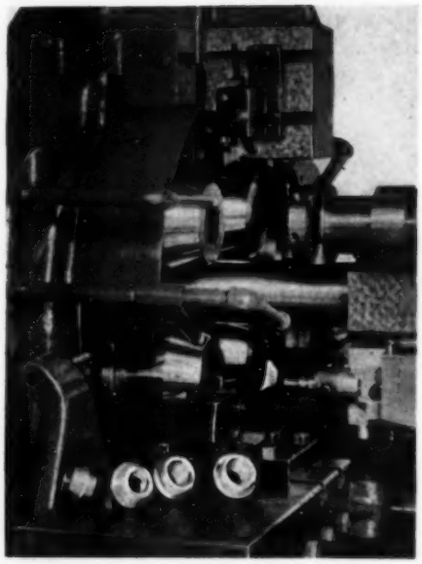
Contour Calculations for Forming Tools



Time-saving possibilities of forming tools are often overlooked because the procedure for calculating the correct contour is not generally understood. This set-up in a Cleveland automatic is typical of many employing forming tools to advantage

O. A. JOHNSON

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ONE OF the most perplexing, tedious problems that confronts a tool designer is the design of forming tools. When forming parts having an intricate profile and when there is only a small uniform grinding allowance, as on tapered roller bearing parts, great care must be taken in designing the tools.

For forming steel parts, the tool must have a top rake angle, and the center of the tool (speaking of circular tools) must be located a certain distance above or below the center of the work, as the case may be, in order to give sufficient clearance.

If there are at least two different diameters on the work, and we have a rake angle on the tool, one point on the tool will cut on center of the work and the other point will cut below center of the work, as illustrated in Fig. 1. This will cause the cutting edge to form a concave surface in the product, and if it is important to keep this surface straight, the tool must be ground at an angle in order to have both points cut on center of the work as illustrated in Fig. 2. Now, when considering Fig. 1 and Fig. 2, we see that the tool will not have the same profile as the product, because:

1. The center of the tool is located above or below the center of the work.
2. The tool has a rake angle.
3. The cutting edge of the tool has been ground at an angle to bring both points on the tool to the center of the work.

When designing the tool, these three conditions must be taken into consideration. Some have tried to solve this problem by the projection method, laying out the tool in actual cutting position. This method requires a skilled engineer, and the layout would have to be made several times actual size in order to give sufficient accuracy for tools for tapered roller bearing parts or similar precision jobs. In some cases, it would be impossible to do this. Other designers use the cut and try method, but this is expensive and inaccurate. Much time is wasted in regrinding the cutting edge of the tool in an attempt to produce the same form as before the tool was sharpened.

Considering the problems that arise in designing forming tools by these inadequate methods, some machine tool makers have thought it impossible to use forming tools on their machines. In one case, I know that thirteen tools have been used to form the different steps on a product where all operations could have been made with two forming tools.

I shall endeavor to show how a forming tool, having an intricate profile, should be designed and calculated so that it will make the correct product

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To cut steel efficiently with a forming tool, proper rake angles must be provided. But these angles, plus differences in the centers of the tool and work, will distort the form. A series of articles, the first of which follows, tells how to compensate for these variations and to obtain correct tool dimensions

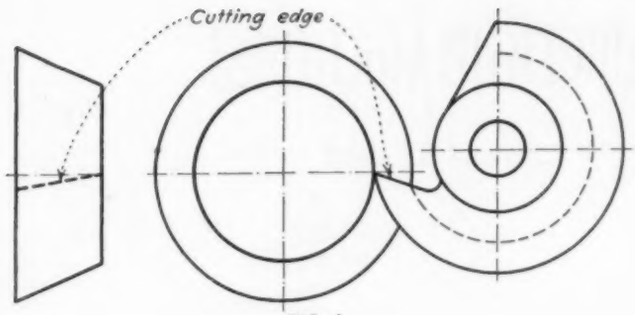


FIG. 1

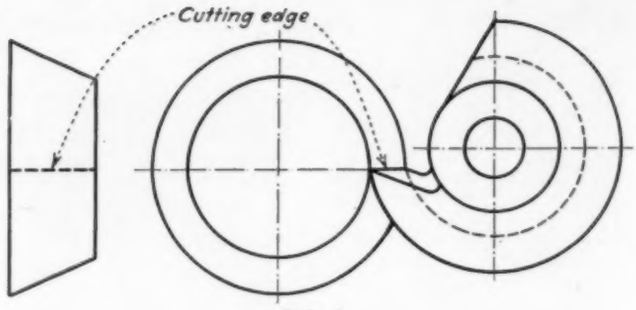


FIG. 2

Fig. 1—Top rake throws some of the cutting points of the tool off the center line of the product. Fig. 2—If the tool is ground at an angle to correct this, the form will still differ from the desired shape of the work

to the greatest precision at the first set-up of the tool.

Circular forming tools may be divided into four different classes:

1. External forming tools, feeding at 90 deg. with the center line of the product.
2. Internal forming tools, feeding at 90 deg. with the center line of the product.
3. External forming tools, feeding at an angle less than 90 deg. with the center line of the product.
4. Internal forming tools, feeding at an angle less than 90 deg. with the center line of the product.

Only in a few cases can a flat forming tool be designed to feed at an angle less than 90 deg. with the center line of the product; but a circular tool affords much better clearance, so we will discuss only two classes of flat forming tools:

1. Flat forming tools, feeding radially at 90 deg. towards the center of the product.
2. Flat forming tools, feeding tangentially at 90 deg. (shaving tools or skiving tools).

We will take a practical example. Let Fig. 3 be the inner race ring of a tapered roller bearing. We will machine this part on a four-spindle automatic machine from tubing stock. To take full advantage of all four spindles, we will use one first rough forming tool on the first spindle, one second rough forming tool on the second spindle, one flat finishing (shaving tool) on the third spindle and the cut-off tool on the fourth spindle. The roughing tools may be either flat or circular depending on the requirements of the automatic machine. Design and calculations of both types will be thoroughly explained. See Figs. 4 and 5.

Flat finishing tools may be calculated in three different ways:

1. The tool may be calculated to be ground at 90 deg. with the sides of the tool, the highest point on the tool to stop just on the center of the product as shown in Fig. 6. This method is used by some companies, but Methods 2 and 3 are far better. The least variation in the spindles for Method 1 will cause a variation in the diameters of the product. If because of spindle variation, the tool does not quite reach the center of the product, all the larger diameters will be oversize, and if the tool passes the center of the product, all larger diameters will be undersize.
2. The tool may be calculated to be ground at 90 deg. with the sides of the tool, all points to pass the center of the product as shown in Fig. 7.
3. The tool may be calculated to be ground at an angle less than 90 deg. with one side of the tool as shown in Fig. 8. This tool may also pass the center of the product and is better than Method 2 when the difference between the extreme diameters is relatively large.

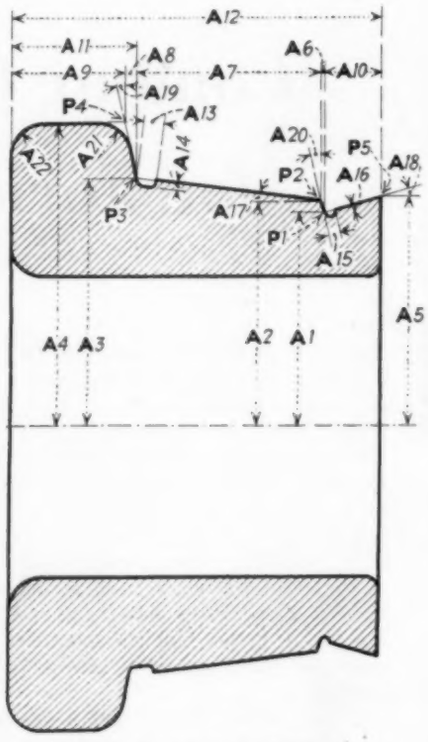


Fig. 3—As an example, a cutter for the bearing cone illustrated will be computed

Fig. 4—Assuming that a four-spindle automatic is used with flat roughing tools, the position of the spindles is shown. Fig. 5—The set-up when circular rough forming tools are used

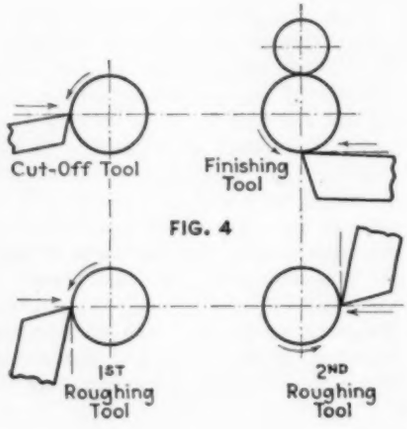


FIG. 4

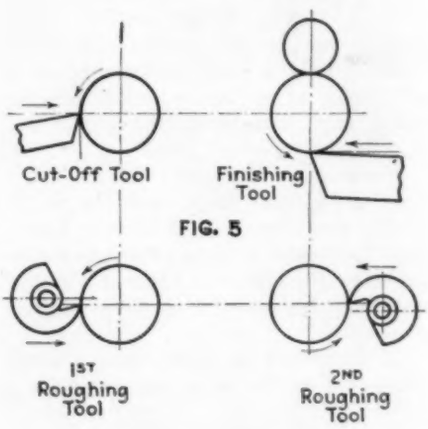


FIG. 5

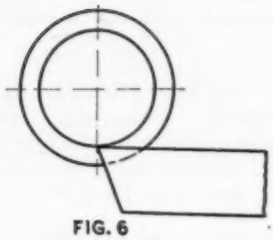


FIG. 6

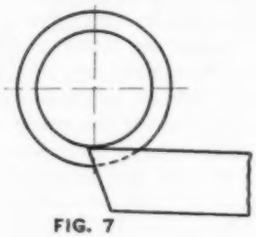


FIG. 7

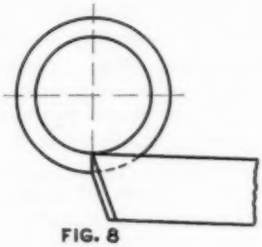


FIG. 8

Figs. 6, 7 and 8—Three possibilities in grinding the tool in relation to the work are illustrated above

Fig. 9 is an enlarged sketch of the tool in position for finishing the part shown in Fig. 3, and Fig. 10 is a layout of the tool profile. First of all, the tool clearance angle *B1* and the rake angle *B2* should be determined. An angle of about 30 min. for *B1* will work satisfactorily for any kind of steel, but angle *B2* should be varied for different kinds of steel. For this job, we will make angle *B2* 19 deg. 30 min., making a total of 20 deg. for *B3*. Before starting the tool calculations, all the important points on the product should be numbered, and the radius from each point to the center of the product, as well as the distance from one point to another parallel with the center line of the product, should be calculated.

Vegas logarithmic tables are used for all calculations. Each figure should be calculated to five decimal places, so the working drawings will be correct to four places. Referring to Figs. 9 and 10, the computations follow:

$$A1 \times \sin B2 = B4$$

$$\frac{B4}{A2} = \sin B5$$

$$A1 \times \cos B2 = B6$$
$$A2 \times \cos B5 = B7$$
$$B7 - B6 = B8$$
$$B8 \times \cos B3 = B9$$

$$\frac{A6}{B9} = \tan B10$$

$$\frac{B4}{A3} = \sin B11$$

$$A3 \times \cos B11 = B12$$
$$B12 - B7 = B13$$
$$B13 \times \cos B3 = B14$$

$$\frac{B14}{A7} = \tan B15$$

$$B15 + B10 = B16$$

$$\frac{B4}{A4} = \sin B17$$

$$A4 \times \cos B17 = B18$$
$$B18 - B12 = B19$$
$$B19 \times \cos B3 = B20$$

$$\frac{A8}{B20} = \tan B21$$

$$B21 + B15 = B22$$

$$\frac{B4}{A5} = \sin B23$$

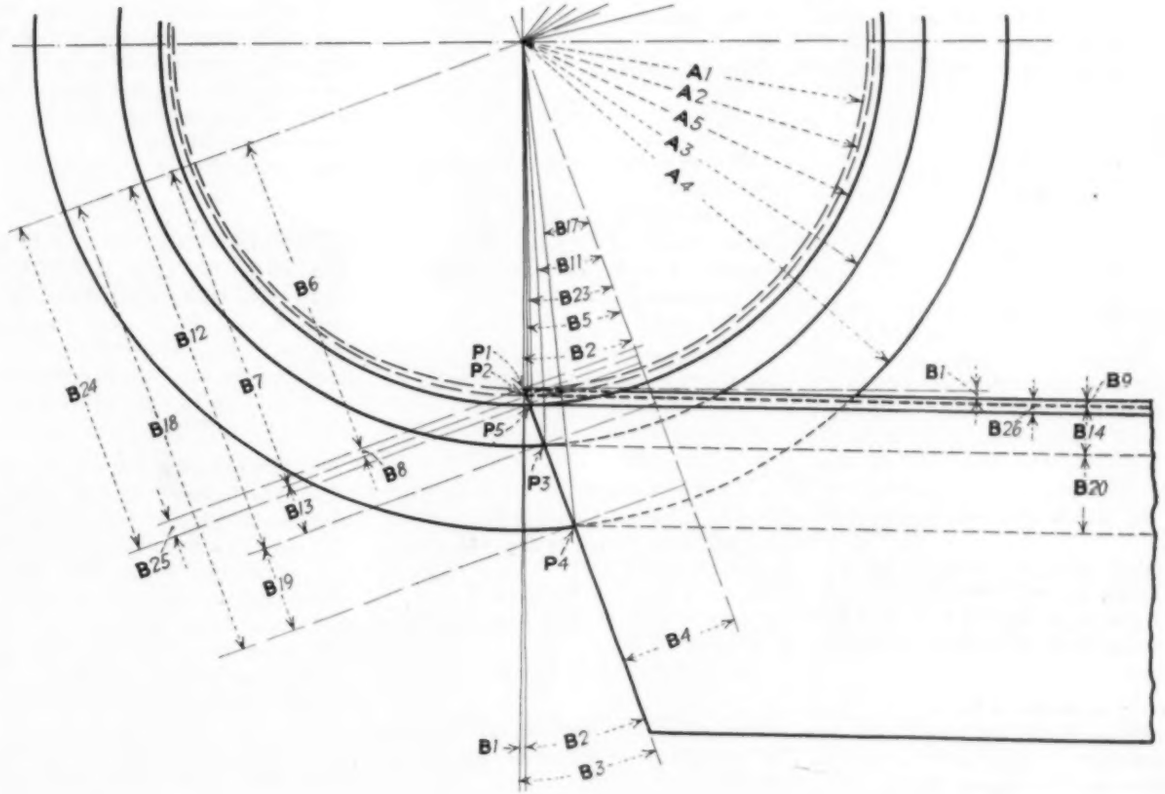
$$A5 \times \cos B23 = B24$$
$$B24 - B6 = B25$$
$$B25 \times \cos B3 = B26$$

$$\frac{B26}{A10} = \tan B27$$

$$\frac{B9}{\cos B10} = B28$$

$$B28 - B16 = B29$$

Fig. 9—From an outline of the tool in relation to the work, the cutting points may be projected and their positions computed



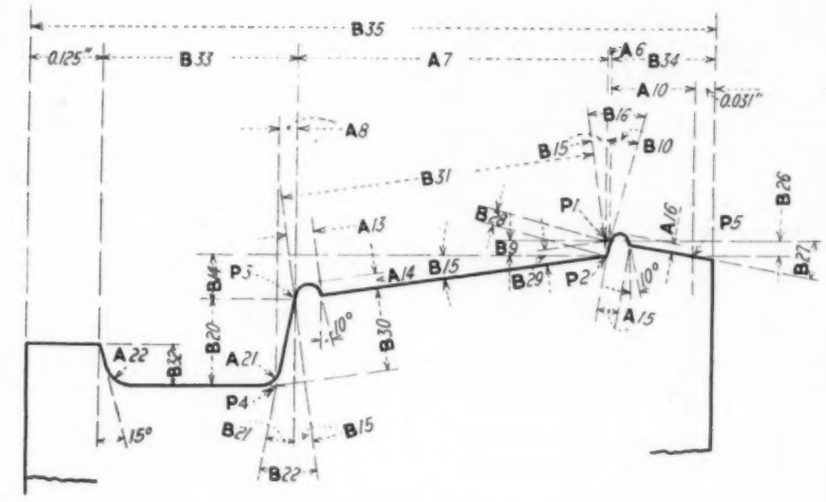


Fig. 10—Dimensions marked *B* on the tool contour are those obtained from calculation

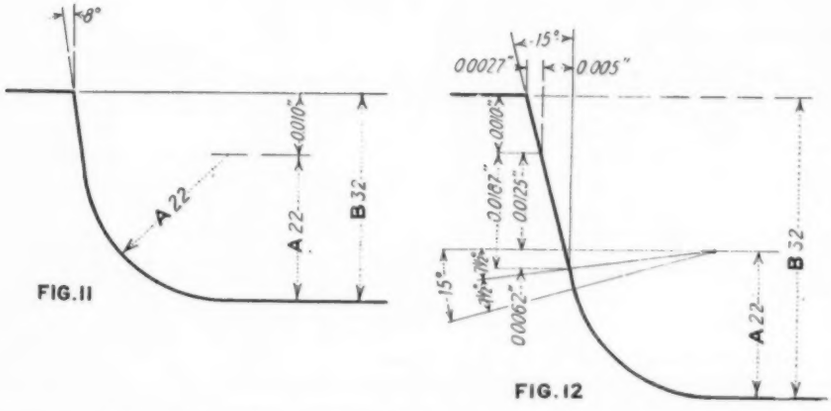


Fig. 11—A minimum clearance of 8 deg. should be provided at the end radius. Fig. 12—This may be increased in proportion to the amount of grinding clearance allowed

$$\frac{B20 \times \cos B22}{\cos B21} = B30$$

$$\frac{A7}{\cos B15} = B31$$

For forming the radius at the large end of the product, the tool should have a tool clearance angle not less than 8 deg., and dimension *B32* should be a little larger than the radius. See Fig. 11. We will assume that 0.005 in. is to be ground from the large end of the product. The proper way to design the end of the tool in this case is shown in Fig. 12.

Assuming values of 0.5938 in. for *A1*, 0.6104 in. for *A2* and 0.00293 in. for *A6*, the first few steps applied to a tool for work of specified dimensions would be as follows:

$\log A1 + \log \sin B2 = \log B4$
$\log 0.5938 + \log \sin 19\frac{1}{2}$ deg. $= \log B4 = 9.2971355$
$\log B4 - \log A2 = \log \sin B5$
$9.2971355 - \log 0.6104 = \log \sin B5 = 9.5115210$
$B5 = 18$ deg. 56 min. 57 sec.
$\log A1 + \log \cos B2 = \log B6$
$\log 0.5938 + \log \cos 19\frac{1}{2} = \log B6 = 9.7479868$
$B6 = 0.55974$
$\log A2 + \log \cos B5 = \log B7$
$\log 0.6104 + \log \cos 18° 56'57'' = \log B7 = 9.7614171$
$B7 = 0.57732$
$B7 - B6 = B8$
$0.57732 - 0.55974 = B8 = 0.01758$
$\log B8 + \log \cos B3 = \log B9$
$8.2450189 + \log \cos 20$ deg. $= \log B9 = 8.2180047$
$\log A6 - \log B9 = \log \tan B10$
$7.4668676 - 8.2180047 = \log \tan B10 = 9.2488629$
$B10 = 10$ deg. 3 min. 27 sec.

Continuing this method, the remaining tool dimensions may be derived accurately.

· NEW BOOKS ·

PRICING FOR PROFIT—*By W. L. Churchill, Consulting Industrial Economist-Engineer. 271 pages 5½ x 8½ in. Published by the Macmillan Co., 60 Fifth Ave., New York, N. Y. $3.00.*

Starting with the basis that profit is simply a surplus in the form of time, goods or money in excess of that required for bare existence, the author points out that all progress from the cave dwelling days is the result of such profit. He also shows that excess profit, even if it be legal and respectable is in reality plunder that ultimately penalizes all concerned. It is, therefore, to our selfish interest to insist that all our transactions be reasonably profitable to both buyer and seller. The buyer benefits most when the seller makes sufficient profit to enable him to develop a better product and improve his methods of manufacture.

Among the phases of business discussed are the law of quantity or probable market; ratio of selling to profit; pricing for profit; wages, salaries and profits; obtaining profitable prices; synchronizing sales and production; advertising; reducing costs and price corrections. From a wide experience in various industries Mr. Churchill has discovered what he believes to be new economic laws that govern profits, how their application assures proper returns to labor, management and capital. These laws and their applications in individual cases are given in the book and can hardly fail to interest all who are responsible for the success of any enterprise, especially in these times.

ENGLISH-FRENCH DICTIONARY OF THE AUTOMOBILE AND ALLIED INDUSTRIES—*By Lewis L. Sell, Ph.D. 768 pages, 5¼ x 7½ in. Flexible clothboard covers. Published by the International Dictionary Company, 15 Park Row, New York, N. Y. Price $6.00.*

Something over 150,000 listings and terms are included in this comprehensive two-language technical dictionary. Not only are terms listed that relate to the automobile itself, but also those terms used to describe its parts, tools for construction, maintenance and repair, even those for motoring and an engine's mechanical operation. Exceptionally complete, this is a unique and practical reference book for the executive or sales executive engaged in export of automotive or associated equipment.

Pressure Angle and Center Distance for Tight-Meshing Gears

SAM TRIMBATH
Gear Consultant

Variations in tooth thickness will change the center distance and pressure angle when gears are tightly meshed to take up backlash. Computation for these values may be simplified by assuming equal gears having average numbers of teeth equal to the average in a given pair.

Assuming the accompanying figure to be a pair of 5-pitch, 20-tooth gears, having a basic pressure angle of 20 deg. and a tooth thickness of 0.300 in., the example works out as follows:

4.000 = Nominal or standard center distance
3.7588 = Base diameter
0.31416 = Nominal or standard tooth thickness
ϕ = 20 deg. = 0.34907 in radians
tan $\phi = \alpha$ in radians = 0.36397
$\alpha - \phi = \zeta$ = 0.01490 in radians

$$\frac{0.31416}{4.000} = 0.07854 = \gamma \text{ in radians}$$

$$\frac{0.300}{4.000} = 0.07500 = \gamma' \text{ in radians}$$

$\gamma - \gamma' = 0.00354$ = Decrease in ζ
$0.01490 - 0.00354 = 0.01136 = \zeta'$
From a table of involute functions
(*AM* — Vol. 64, page 558)
This value of ζ' gives $\phi' = 18$ deg. 19 min.

$$\frac{3.7588}{\cos \phi'} = \frac{3.7588}{0.94933} =$$

$3.9594 = OO'$

For gears of unlike number of teeth and tooth thickness, for example, 15 x 25 combination, 0.314 and 0.300 tooth thickness respectively, 5 pitch, having a basic pressure angle of 20 deg.:

20 = Average number of teeth
4.000 = Average pitch diameter and center distance
0.307 = Average tooth thickness
3.7588 = Average base diameter
ϕ = 0.34907 radians
α = 0.36397 radians
ζ = 0.01490 radians
γ = 0.07854 radians

$$\frac{0.307}{4.000} = 0.07675 = \gamma'$$

$\gamma - \gamma' = 0.00179$ = Decrease in ζ
$0.01490 - 0.00179 = 0.01311 = \zeta'$
For this value of ζ', $\phi' = 19$ deg. 11 min., the new pressure angle

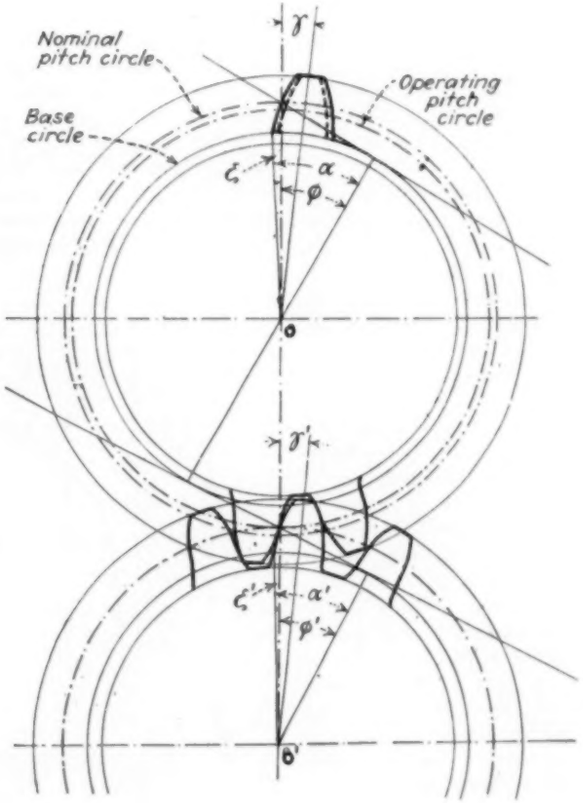
$$\frac{3.7588}{0.94447} = 3.9798 = OO'$$, the new center distance

STANDARD gears are assigned certain basic pressure angles such as 14½ deg. or 20 deg. For any given diametral pitch, the tooth thickness and center distance are found by the simple formulas:

$$\frac{3.1416}{\text{Twice the diametral pitch}} = \text{Tooth thickness.}$$

$$\frac{\text{Total number of teeth in combination}}{\text{Twice the diametral pitch}} = \text{Center distance}$$

Theoretically, gears cut to standard thickness will operate at standard centers, without backlash and at the basic pressure angle, but it is sometimes necessary to know the centers at which gears will mesh tightly for a tooth thickness which deviates from standard. The formulas at hand for determining this are quite simple as long as the number of teeth and tooth thicknesses are alike in each gear of a pair, but become somewhat complex for ready reference when mating gears are not similar. However, they can be reduced to the same simplicity by assuming the gears to have a number of teeth and tooth thickness



Tests Show

Wide Temperature Variations Inside Heat-Treating Furnaces

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Westinghouse Electric & Manufacturing Company

IN ANY heat-treating furnace, fuel-fired or electrically heated, the temperature of the charge reaches uniformity after a reasonable period. This assumption has been generally accepted and forms the basis of automatic temperature control. Is it valid?

Lack of uniformity in certain products that had passed through heat-treating operations of various types raised this question in the minds of Westinghouse engineers and led to a series of careful tests to determine the facts. The results point the way to the clearing up of heat-treating difficulties that have plagued production men and metallurgists in all sorts of metal-working plants.

In starting this investigation, a crew of experienced test men was organized. Gas and electric meters, pyrometers, thermocouples and switches were made available. The pyrometers and thermocouples were tested for accuracy before each test. Accuracy of results was the first consideration, and no expense was spared to that end.

Preliminary tests indicated that there may be a considerable temperature difference between the temperature of the furnace thermocouple and that of the material being heat-treated, hence it became necessary to consider means for accurately measuring temperatures directly within the charge, if possible. In many cases, the product was of such a nature as to preclude the possibility of drilling holes in the material being heat-treated, and inserting the thermocouples directly into such sections or parts. In such cases it was necessary, in order to obtain accurate results, to have test blocks made up of the same material and of the same cross section as that being heat-treated, and to measure the temperature in the center of such test blocks.

The tests on each furnace were repeated a sufficient number of times to insure the final and accepted result being the very best the particular furnace could do consistently. Wherever it was thought that the performance of the furnaces could be bettered, as by regulation of the burners, varying the air and gas mixtures, or even to the extent of installing new burners, which was done in two cases, or completely rebuilding the interior of the furnace, which was also done in one instance, such changes and improvements were made, and the tests then repeated.

The applications investigated and reported upon consisted of the following heat-treating processes:

1. Annealing copper.
2. Annealing and normalizing steel castings.
3. Normalizing, carburizing, hardening and tempering of carbon steel.
4. Annealing high speed steel.
5. Hardening and tempering high speed and carbon steel dies.
6. Heat-treating aluminum alloy castings.
7. Melting aluminum.
8. Heating plates for forming tank headers.
9. Annealing sheet steel.
10. Normalizing, hardening and tempering of alloy steel.

To illustrate the thoroughness of the tests details of the ones made on a car-type gas furnace used for normalizing

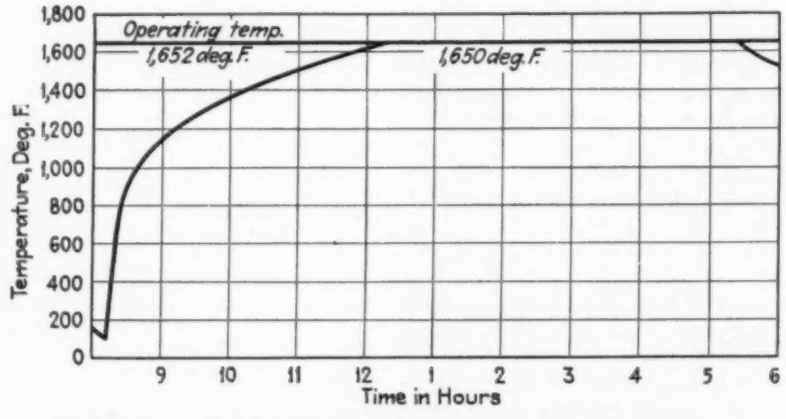
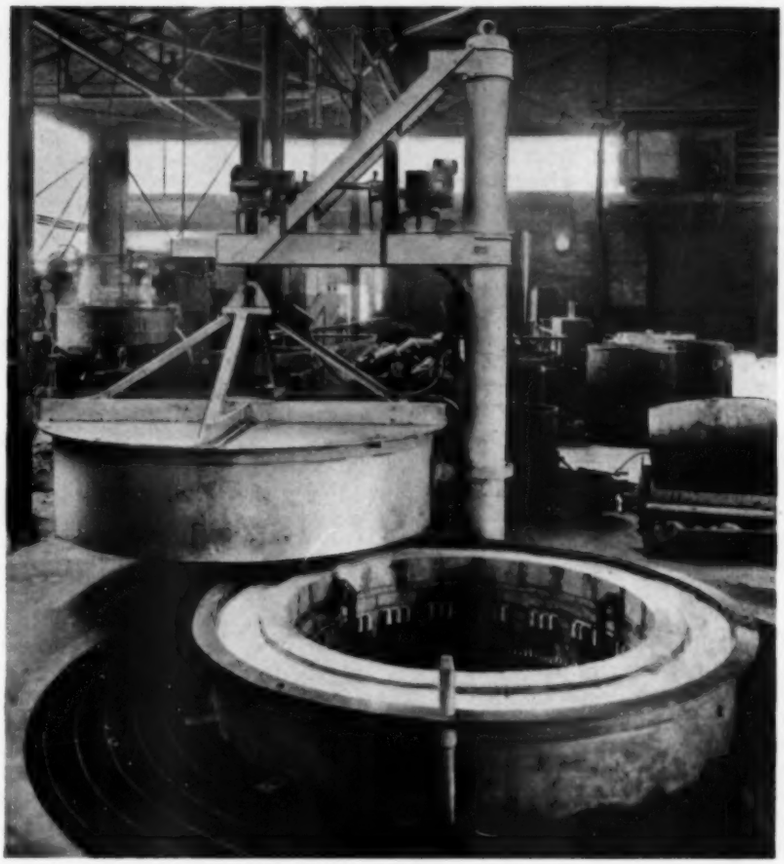


Fig. 1—Automatic temperature control record of a gas-fired furnace used for annealing steel castings

steel castings are given. This furnace had a height of 4 ft. to the springing line of the arch. The loading area of the car was 4 ft. 6 in. x 13 ft. A normal charge was 16,000 lb. of miscellaneous castings, and the process specifications required that the castings be brought to 1,652 deg. F. and held there no longer than necessary for complete saturation.

The furnace was of a modern design, and only nine months old. Eight gas burners were used, four on each side, staggered. The burners were placed high in the furnace chamber so as to prevent the gas flame from impinging directly on the charge. Outlet ports were placed opposite each burner on the opposite side, but down on the side wall on a level with the floor of the car. Automatic temperature control was used.

A typical temperature control chart, Fig. 1, showed that the temperature of the furnace came up to 1,652 deg. F., and remained at that temperature for five hours, with a temperature variation of only two or three degrees from normal. It was assumed, due to this remarkable temperature control, that the charge also reached this same temperature, eventually, and was being heat-treated as accurately as shown by the recording pyrometer record. The



Electrically-heated pit-type furnace for heat-treating aluminum alloy castings

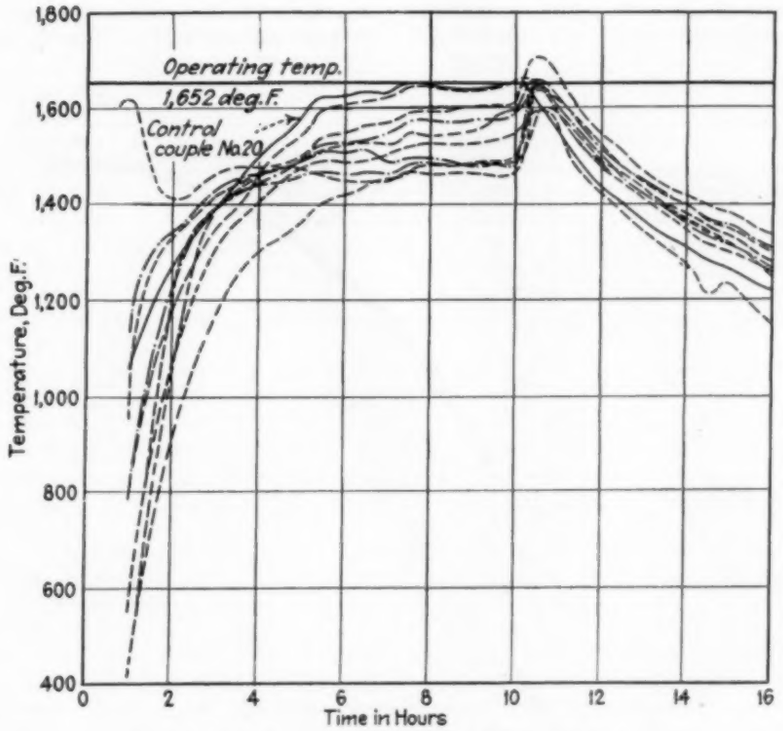


Fig. 2—Actual temperatures recorded by the nine even-numbered thermocouples out of eighteen distributed through the charge of the gas-fired furnace of Fig. 1

thought was prevalent in this company, as seems to be the general conception, that if a furnace is held at a definite temperature long enough the charge, eventually, must reach that same temperature.

The first test made on this furnace completely disillusioned everyone as to the real value of automatic control. A temperature of 2,400 deg. F. was recorded in one of the top castings. At the end of the five hours soaking period, a difference in temperature of 790 deg. F. still remained within the castings.

Following this test, five additional tests were made on this furnace, about ten days apart, during which time every practical improvement was considered and changes made to improve the performance as much as possible. In addition to changes made in the furnace, the height of the charge was reduced so as to avoid as much as possible the high temperature condition. The charge was also raised higher above the car floor, so as to allow the convection currents to sweep underneath, and heat the bottom of the charge.

A sixth and final test was made to determine as accurately as possible just what percentage of the charge would come within the process specifications for the heat-treatment for steel castings. The charge was reduced to 9,910 lb. in

order to obtain as favorable loading and heating conditions as possible.

Eighteen thermocouples were placed within the charge. Each thermocouple was imbedded in a cast steel block 4 in. x 4 in. x 8 in. long, from which test samples were to be obtained for metallurgical tests. Fig. 2 shows the temperature distribution as recorded on the "even" numbered thermocouples, Nos. 2 to 18 inclusive. The "odd" numbered thermocouples (not shown) produced a curve substantially the same.

The cast steel blocks were drilled to the center lengthwise, the thermocouple inserted, and then sealed in place, so that the temperatures recorded were temperatures 2 in. under the surface, corresponding to like sections of steel castings being annealed. A reading was also taken direct from the control thermocouple, and a curve plotted as shown by the heavy line marked control couple No. 20, Fig. 2.

During the saturation period, from 10 p.m. to 2 a.m., or four hours, the curves assumed practically definite parallel trends, many of them showing that regardless of the length of time the charge remained in the furnace such parts would not increase in temperature, and that for a given furnace temperature, the charge had reached a saturated condition, but would never come up to 1,652 deg. F.

At the end of the heating cycle, the maximum temperature was 1,638 deg. F. and the minimum temperature 1,443 deg. F., or a temperature difference of 195 deg. F. Thermocouple No. 12 was placed adjacent to the control thermocouple, at the highest point of the charge and thermocouple No. 18 was placed in the center of the furnace, in the air, approximately 12 in. above the charge.

Only one thermocouple or approximately one-seventeenth of the charge came within the temperature specifications. This performance could have been bettered (neglecting a very important phenomenon which occurred) had the control temperature been set for 950 deg. C., instead of 900 deg. C., which would have raised the general shapes of all curves approximately 50 deg. C.

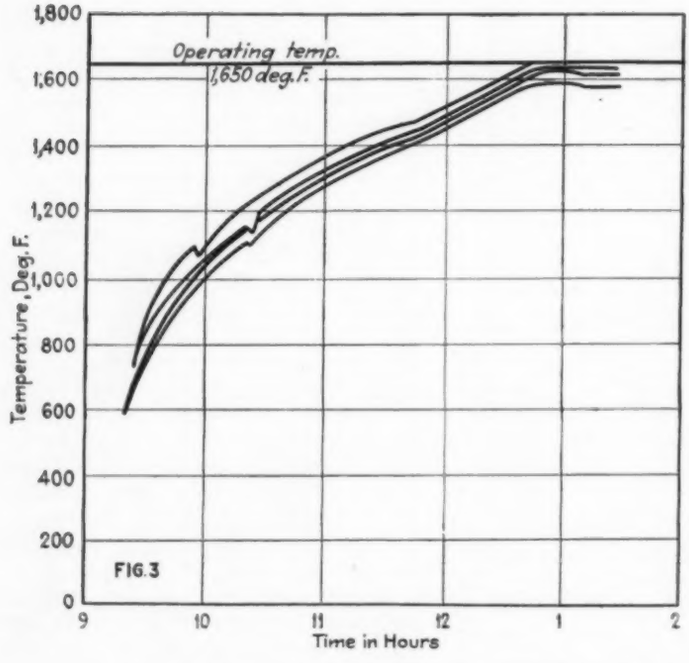
This was an annealing heat-treatment, in which the charge was given a "slow cooling," the doors remaining closed. A phenomenon occurred in that there was a temperature increase after the gas and air were cut off. It would appear from the curves in Fig. 2 that the sudden rise in temperature took place before the gas was cut off, but the fact is apparent, when it is understood that these were point-to-point curves, the reading taken every half hour, one reading being taken at 2 a.m. and the next at 2:30, with the curve rounded out to indicate probable temperature trends between point. Undoubtedly, in this case, the temperature curves actually continued more or less in straight lines clear up to the time the gas was cut off, and then suddenly jumped anywhere from 50 to 200 deg. F., depending upon the location of the thermocouples.

The thermocouples were imbedded in blocks of cast steel, hence the temperatures were not flash temperatures. Furthermore physical tests made on samples cut from the test blocks showed properties corresponding to the higher temperatures reached after the gas was cut off, and not the properties which would have resulted from the temperatures just prior to cutting off the gas.

Corresponding tests on a gas-fired box-type furnace used for heat-treating gears showed the curves illustrated in Fig. 3. In this case the charge of twelve gears weighed 1,700 lb., and the desired temperature was 1,625 deg. F., with limits of 1,610-1,640 deg. F. When the gear in the center of the furnace came within these limits, the temperatures of other gears varied from 1,570 to 1,670 deg. F., or from 55 deg. F. below to 45 deg. F. above the desired temperature.

In another test of a gas furnace used for heat-treating automobile crankshafts, a variation in the charge of from 50 to 112 deg. F. from the desired 1,500 deg. F. was noted. The variation in a single shaft was found to be 63 deg. F.

In such a case as this, the user undoubtedly thinks that his hardness tests are as rigid as can be met in any type of furnace, believing, as he does, that the product is being heat-treated at temperatures varying not more than 5 deg. F. from the correct heat-treating temperature. Whether he knows it or



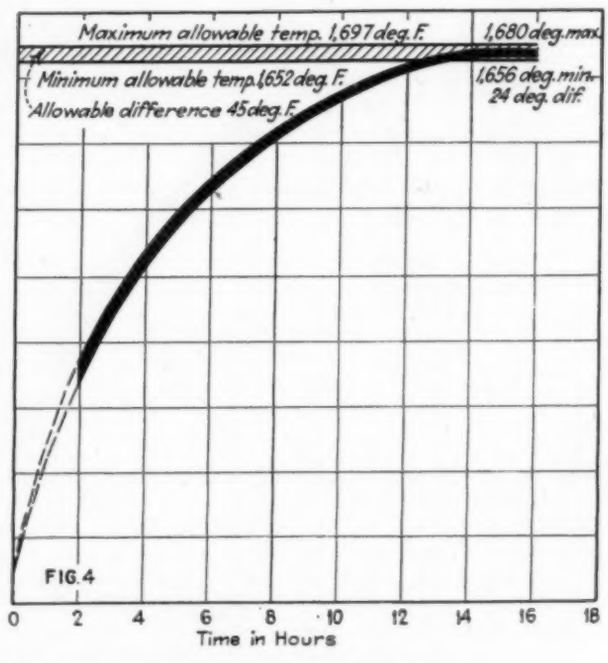
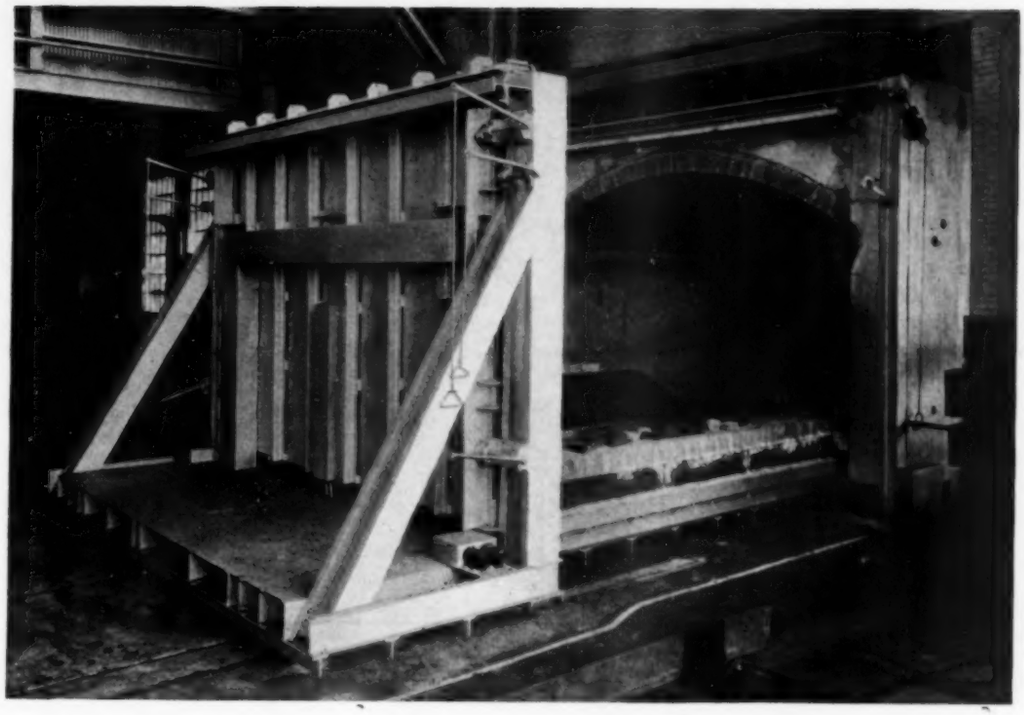


Fig. 3—Thermocoupler temperature records from a gas-fired box-type furnace used for heat-treating gears. Fig. 4—Thermocouple temperature records from an electrically-heated car-type furnace used for normalizing motor frames.



Car-type electric furnace designed for annealing and normalizing steel castings

not, his tests must be based on a temperature variation of 50 deg. F. plus or minus.

Contrasting with these rather wide variations in charge temperature are some results of tests on electrically-heated furnaces. Fig. 4 shows the combined readings of twelve thermocouples located in a car-type furnace used for normalizing steel motor frames. All fall within the limits of 1,652-1,697 deg. F. specified.

In making this test each thermocouple was imbedded in the center of a cast steel block 4 in. x 4 in. x 8 in., which later was used as a test specimen. The thermocouples were placed as follows:

One test block at each extreme corner of the car.

One test block on each extreme side of car.

Six test blocks distributed throughout the charge, bottom, center and top.

The twelve thermocouples were so located as to cover all possible temperature zones of the charge which totaled 16,000 lb.

The larger castings being heat-treated had a cross section of approximately 4 in. Hence, reliable information was desired as to the manner in which such castings absorbed the heat, and as to whether the entire charge, within a reasonable time, would reach the temperature conditions called for in the process specifications. Readings were taken every 30 min. by means of a potentiometer type pyrometer, which together with the thermocouples, had been carefully calibrated before beginning the test.

Another electric furnace test, on a hearth-type furnace used for heating steel plates for deep drawing, showed equally good results. Of the twelve thermocouples distributed through the furnace, one showed a variation from normal of 7.2 deg. F., three of 5.4 deg. F., and the rest of 3.6 deg. F. All, of course, were well within allowable limits.

Still another test was made on an electric pit-type furnace for heat-treating aluminum alloy castings. The weight of the charge was 1,500 lb., the operating temperature 955 deg. F., the permissible variation 10 deg. F., the time to reach 955 deg. F., was 6 hours, and the charge was held there for 40 hours.

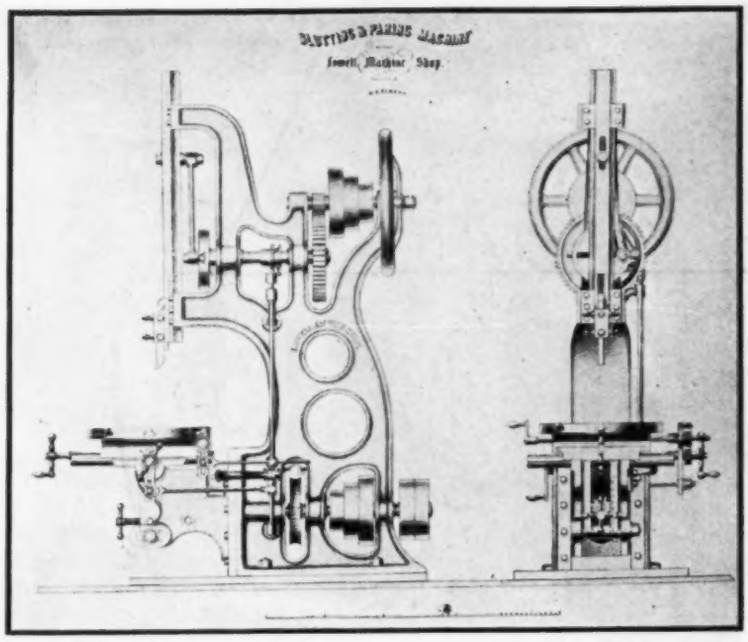
Maximum Variation 5.4 Degrees

Fifteen thermocouples were distributed throughout the charge. The maximum temperature variation was 5.4 deg. F. Five thermocouples were exactly at 955 deg. F., one at 954 deg. F., six at 952 deg. F., and three at 959 deg. F. These temperatures were maintained during the 40 hours.

The results of these tests on high grade and well maintained gas and electric furnaces indicate that there must be many plants throughout the country which are laboring under a serious handicap and misapprehension as to the results they are actually securing. Operators of furnaces defend their positions with the statement that their product must be entirely satisfactory, because it passes the tests. So did the product of the dozen or more gas furnaces tested. The entire situation resolves itself into a question as to the kind of product a customer is satisfied to produce.

If a variation of 200 deg. F. within the charge is satisfactory, then almost any kind of a furnace will do the job, provided it has sufficient production capacity. If 100 deg. F. is the maximum limit in variation in temperature, or 50 deg. plus or minus from a given temperature, then more careful consideration must be given as to the furnace. If a temperature variation of 25 deg. F. plus or minus is desired, there seems to be very little likelihood of these conditions being met in a fuel furnace, except in a limited manner, and by wholesale rejections of all products not coming up to the set requirements.

With a properly designed electric furnace, it is practical to obtain heat distribution throughout the entire charge of 10 deg. F. plus or minus, from a given point, or even closer results if such are required. Once these conditions are attained, they are fixed and unchanging, insofar as a uniform liberation of heat to the charge is concerned. An electric furnace can be made to operate with machine-like precision, producing results worth many times the investment charges and power costs. These two items, which in the past had appeared as deciding factors, assumed their proper proportions when all facts were established.



In 1845, William B. Bement became associated with the Lowell Machine Shop. Here is one of his early machine tool drawings

Machine Tool Beginnings

JONATHAN T. LINCOLN

In "The Invention of the Slide Lathe" *(AM—* Vol. 76, page 168), the author expressed the opinion that David Wilkinson, an early American machinist, should share equal honors with Henry Maudslay and other English inventors in the development of machine tool building. He now traces further steps during the next generation

IN THE United States, tool building did not become a specialized industry until about 1850. After that year, its progress was rapid and William Sellers & Company—established in 1848, as Bancroft & Sellers—soon set a new "world standard," receiving high honors at the Paris Exhibition in 1867 and, six years later, at Vienna, the highest distinction. In 1851 at the London Exposition, Whitworth, the English builder, had been without a rival.

Only recently the writer had occasion to examine the early records of a number of the pioneer American machine companies, which were established in New England during the first half of the Nineteenth Century, and found that the history of all of them follows, with reference to product, an identical pattern. First erected to make machinery for cotton textile manufacture, these shops came in time to build machines for the other industries that rapidly developed in response to a new force in the national economy—the persistent growth of domestic manufacturer. During the first period of their history, the New England machine shops were characterized by a highly diversified product, then gradually, with the advent of improved means of transportation widening the market for their manufactures, and because the earlier industries were advancing toward maturity, the shops ceased to build "machinery in general"—a familiar phrase in the advertisements of the period—and came more and more to build machinery for specific purposes. By 1850 this tendency toward specialization was well defined but, regardless of other products, most of the shops continued to build machine tools, primarily for their own use. Not infrequently, duplicates of the tools thus originated became the property of other manufacturers either by the loan of patterns or by outright sale of finished machines. A specific instance is afforded by the records of Corliss, Nightingale & Company, the forerunner of the Corliss Engine Works, and established late in the period of diversification.

In 1845, George Corliss, who prior to the granting of Howe's celebrated patent, had invented a sewing machine intended primarily for the use of shoe manufacturers in stitching leather, moved from the State of New York to Rhode Island for the purpose of perfecting his machine and to make arrangements for building it. He became associated with Fairbanks, Bancroft & Company, a firm that had already begun to specialize in building steam engines. A little later he formed a partnership with John Barstow and Edwin J. Nightingale under the firm name of Corliss, Nightingale & Company, to build steam engines, embodying his own epoch-making improvements. This was the beginning of the Corliss Steam Engine Company, one of the earlier of the specialized shops. Nevertheless this concern built many machine tools and sold them to other shops. A memorandum book left by Corliss, covering the years 1845 to 1850, which has been preserved with other records of the same company in the manuscript department of the Baker Library at Harvard University, contains many items relating to machine tools designed by Corliss, of

which the following will serve as examples:

"March 15th, 1847. Engaged to loan our planing machine pattern to —— [name is not given] for four sets of castings at ½ cent pr. pound and do the planing and gear cutting at $4 pr. day.

"April 26th, 1847. Agreed to make for Wm. Sellers a planing machine from our 3rd size pattern, by day and pound. Charge for castings 3½ cents. Charge for large planing machine $6 pr. day—other planing machines $3 pr. day, gear cutting machine $4 pr. day, lathes $3 pr. day, except smallest size, for which we should make no charge and should not make any charge for upright drills or any small tools. Work at $2 pr. day.

"August 11th, 1847. Offered to sell to E. Bancroft one of our new hand lathes for $200 cash. Sold as above."

Specialization Begins

These items illustrate the manner in which machine tools were built by many shops during the earlier period, primarily for their own use but also for the market. The last two items are of particular interest in themselves, recording as they do transactions with William Sellers and Edward Bancroft at the very time they were planning to set up in Philadelphia one of the first shops to specialize in building machine tools. Sellers, like Corliss, had been previously employed by Fairbanks, Bancroft & Company—one of the many shops erected in Rhode Island by reason of the demands of the growing cotton textile industry and in which the influence of Wilkinson was a direct factor. In the period of specialization in machine building, Corliss became greatest among the engine builders, and Sellers, as we have seen, set a new standard in the construction of machine tools.

At almost the same time that Bancroft and Sellers were establishing their shop in Philadelphia, another machinist, who had acquired his trade in making cotton-mill machinery, William B. Bement, commenced specializing in machine tools in the same city. This was one of the beginnings of the Niles-Bement-Pond Company, later to become equally important with Sellers in the development of the modern machine tool industry.

Like both Bancroft and Sellers, Bement derived the traditions of tool building from the early Rhode Island machinists, all of whom had been trained under the influence of the Wilkinson tradition. Bement was born in New Hampshire in 1817, the son of a Yankee farmer who was also a blacksmith, and, as a boy, found an outlet for his marked mechanical ingenuity in his father's shop. Then apprenticed to Moore & Colby, who made cotton mill machinery in Peterboro, he became foreman of the shop and afterwards a member of the firm. He early saw the need of improvement in the design of machine tools and followed this interest throughout his life.

The Amoskeag Company, established at Manchester, New Hampshire, in 1824, erected there, sixteen years later, a large machine shop. Here the Rhode Island tradition was strong for among the original owners of the company were Slater himself, as well as Ira Gay and Yarned Pitcher, both Pawtucket mechanics and contemporaries of Wilkinson. In 1840, Bement found employment in the Manchester shop, and when, in 1845, William A Burke, who had charge of the shop, was appointed superintendent of the Lowell Machine Shop, he engaged Bement as an assistant.

The Lowell shop had been established in 1822 by the Merrimack Manufacturing Company under whose management and that of the Proprietors of the Locks and Canals on the Merrimack River it remained an integral part of the local textile industry until 1845, when it became a separate corporation devoted exclusively to the building of machinery. At this time its product, like that of most machine shops of the period, was highly diversified and included, in addition to a full line of cotton mill machinery, locomotive engines, machinery for paper mills and other industries. And like the other shops, its product also included machine tools.

Influence of Railroads

In the case of this company, the records bear no traces of the common practice of loaning patterns but rather give evidence of a well established business in the manufacture and sale of engine lathes, planers, drilling machines and other tools. Because this company was among the first to build locomotives, it was also among the first to give special attention to the development of heavy duty tools. Locomotive building called for heavier and also more accurate machine tools than the manufacture of textile machinery had required. Moreover, it called for a large investment in such equipment, which the Lowell shop wisely capitalized by building tools for the market on an extensive scale, establishing in Boston a special agency for the sale of their equipment.

Among the records of the Lowell Machine Shop now preserved in the Baker Library may be found many specifications of these heavy tools. The collection also contains an interesting series of drawings made by Bement, and one of these drawings is here reproduced, through the courtesy of the Business Historical Society. These drawings are signed as follows: "William B. Bement, designer and delineator." They well illustrate the state of machine tool building in the United States during the period from 1845 to 1851.

Bement's Work

A biography of Bement would include much of the material required to summarize all the stages in the early history of the American machine tool industry—from its beginnings in the Rhode Island cotton factories to its present situation as a compact and highly specialized industry. Bement was of the generation that succeeded Wilkinson's; his tools were designed at a time when lathes and planers, drilling machines and other tools had reached a relatively advanced stage in their development in the North Atlantic States, but his first lathe was built in Indiana where, from 1842 to 1845—the interval between his employment by the Amoskeag Manufacturing Company and the Lowell Machine Shop—he was engaged in making woolen-mill machinery. Here, at Mishawaka, remote from the manufacturing centers of the country, he repeated Wilkinson's experience, building the lathe with hand tools, there being no other lathe or planer within several hundred miles. And as Wilkinson had constructed his screw-cutting machine in his father's forge, so Bement built his in the shop of the St. Joseph Iron Company, where he was allowed to use such tools as the company possessed. In return he permitted the proprietors to use his patterns to make similar tools for themselves, thus furnishing an example of how the use of machine tools, originating in Pawtucket, spread to other parts of the country.

At Lowell, Bement was able to put his experience to advantage in one of the best equipped machine shops in New England and for a period of almost six years devoted himself to improvements in machine design. In 1851, as we have already noted, he moved to Philadelphia to become a member of the firm of Marshall, Bement and Colby, which soon rivalled Bancroft and Sellers as makers of machine tools.

This firm was later consolidated with that of Ferris & Niles, which, under the title of the Machine Tool Works, had also commenced a specialized machine tool business in Philadelphia. Three years after his death, in 1897, the company he had founded became a part of the Niles-Bement-Pond Company, in which were united three of the main lines of tool builders which had originated in as widely separated parts of the country as New England, Pennsylvania and Indiana.

Operations on the Ford V-8 Camshaft

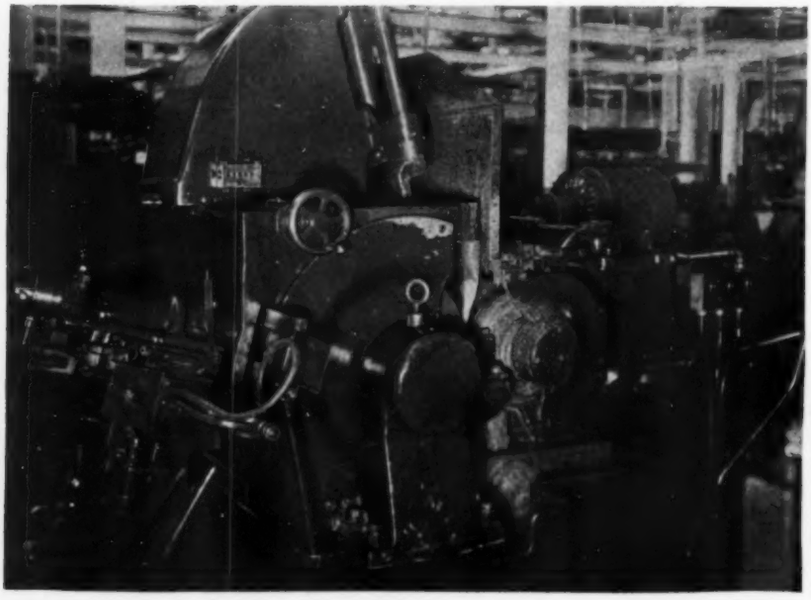


Fig. 1—Camshaft bearings are rough and finish ground in three-wheel centerless grinders using a plunge cut

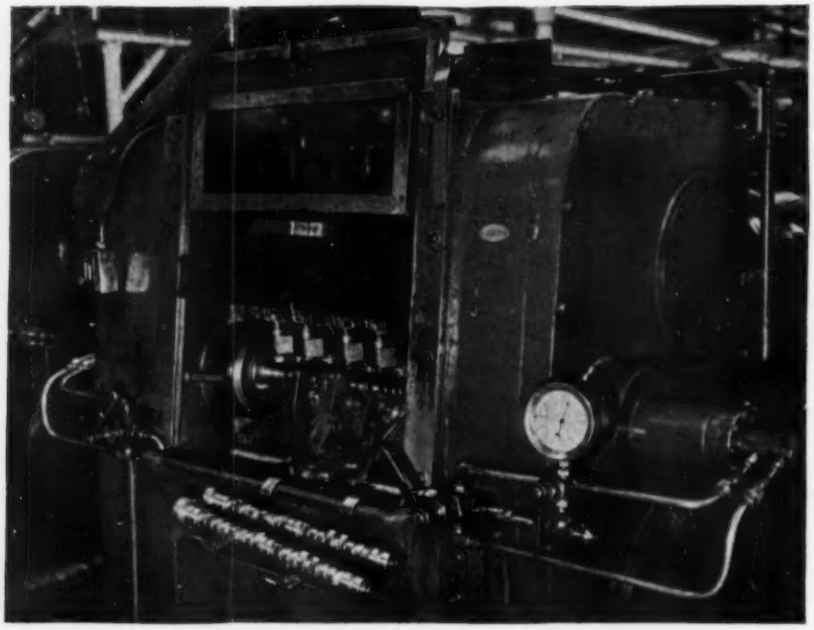


Fig. 2—Eight cams are end-milled at a time in a new machine using two sets of spindles

ON V-TYPE automobile motors, two camshafts are usually employed. But in accordance with the Ford tradition of simplicity and the use of fewer parts, the V-8 built at River Rouge has only one. One bank of cylinders is offset from the other by only 7/8 in., which fixes the center distance of each pair of cams for opposite cylinders. When it is considered that an intake and an exhaust valve cam is required for each cylinder, the camshaft becomes a study in compactness.

But the functions of this part do not end with valve operation. Near the front end is an eccentric which drives the fuel pump. A helical gear on the read end drives the lubricating oil pump through an idler gear. A 56-tooth micarta gear through which the camshaft is driven is mounted on the front end. end. Ford specifications EEE alloy steel forgings are used for the camshaft.

Sixteen cams on one shaft present many problems in machining. How Ford engineers have solved them forms one of the highlights in the production of the V-8 motor

When Ford designers decided on the single 16-throw camshaft, they passed on some interesting problems for the tool engineers to unravel in planning its production. Some operations formerly used on the Model A have been continued for the new design, but certain steps required novel treatment.

An overhead monorail conveyor carries the parts into the machining department, and a series of similar conveyors transports them from one operation to the next. The first eleven operations consist primarily of roughing out the forgings, and in general, closely follow standard practice. The ends are trimmed to length in a rotary mill which takes two cuts, and then they are centered in a double-end machine. The shafts are next straightened in a hand press and spotted in an engine lathe for the center bearing. The cams are then faced, and the gas pump eccentric turned in a single multi-tool operation.

In three engine lathe operations, the oil pump gear bearing is turned, and the flange is faced and turned on the outside

diameter. The flange slot is then cut on a hand-milling machine. For this set-up a fixture is provided which locates the shaft from one of the rough cams. It is necessary that the slot be properly positioned in relation to other surfaces on the forging because it is used in subsequent machining operations to fix the angular location of the shaft. Both ends of the shaft are faced, and the work is inspected and again straightened. Next, the front and rear bearings are rough turned.

A three-wheel centerless grinder, shown in Fig. 1, then simultaneously rough grinds the three camshaft bearings to 1.815-1.816 in. An automatic hydraulic lift feeds the work through this machine. A plunge cut is used on the grinding machine wheels which are actuated by the hydraulic cylinder seen in the iliustration. The forgings are recentered, and the eccentric is semi-finished. A special grooving machine is used to cut the bearing oil grooves.

Entirely new machines designed by the Ford tool engineers are used on the next operation which consists of milling the cams. Eight of the sixteen cams are milled at one time. The shafts are transferred to another machine, and the other eight are milled. This procedure is necessary because of the closeness of the cams. Eight machines are required for this operation, each having a capacity of 45 shafts per hour, which is adequate for the current production schedule.

The process, shown in Fig. 2, is essentially a series of end-milling operations. Each machine has four vertical spindles and four spindles pointing upward at an angle 30 deg. from the horizontal. Each spindle has two feed motions, one axial and the other a swinging motion. The two feeds operate simultaneously to keep the face of the cutter tangent to the cam contour at all times. Each spindle is controlled by a master steel disk which is really two cams in one. The periphery of the disk controls the axial motion of the spindle, while a groove in the face of the disk operates the swinging feed motion.

The camshaft is chucked on the bearing surfaces previously ground and is clamped in place hydraulically. A center rest operated by a toggle device provides additional support. The angular position is fixed from a lug on the chuck which fits in the driving slot previously milled. The machines are driven by 10-hp. motors with a separate motor provided for the hydraulic pump.

A novel feature is the use of the oil for the hydraulic clamps, which upon being released, is forced through the bearings of the machine. Thus, instead of being returned directly to the reservoir, the oil performs the double function of clamping and lubrication. Cutting oil is liberally applied to each cutter during the machine operation. So completely are the cutters flooded with this medium that it is necessary to close a hood while the machine is in operation. Otherwise, the coolant would be thrown out of the machine onto the floor. A glass window permits inspection by the operator during the cut. Chips drop into a pocket at the rear of the machine, from which they are periodically removed. In order to prevent injury to the machine in case the load becomes

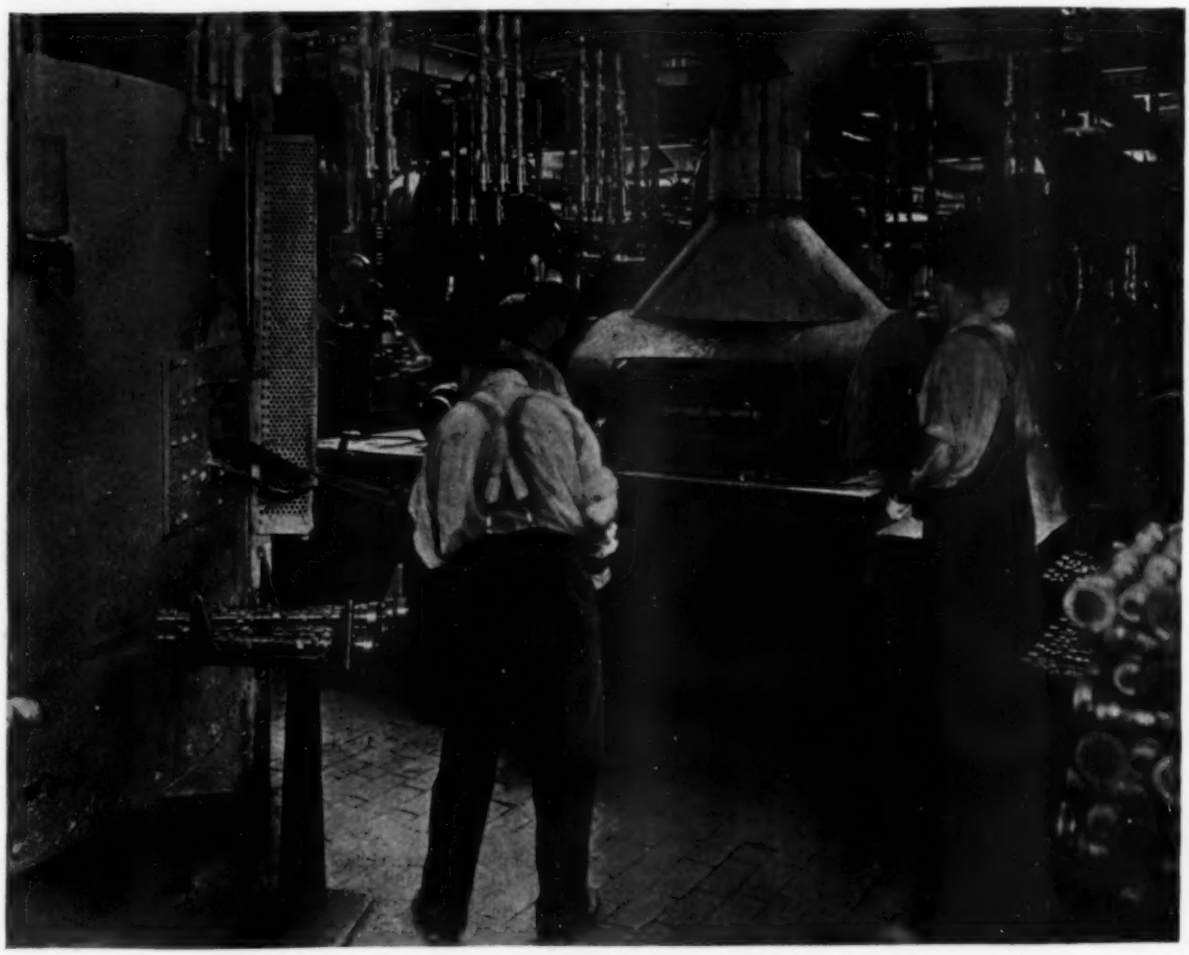


Fig. 3—Uniform heat-treatment is given each camshaft in a rotary electric furnace and an inclosed quenching machine

excessive, as for instance when a cutter breaks, the pulley shaft is provided with a safety clutch. This mechanism controls an electrical interlock which automatically shuts off the motor when the clutch trips.

Helical gears and spiral bevel gears are used throughout the machine to give smooth cutting action and freedom from tooth marks on the surface of the cams. The end mills are of high-speed steel and are run at 610 r.p.m., which gives a maximum cutting speed of 160 ft. per min. The feed is set to give a maximum of 0.005 in. per tooth. The cutters are reground on schedule every eight hours.

Heat-Treatment

Next, the camshafts are put into the electric rotary furnace shown in Fig. 3, where they are carried around on a turntable for 28 minutes and brought to a temperature of 1,470 deg. F. They are then put into a quenching machine which, by means of a rotary fixture, immerses them in a caustic soda solution held at 65 deg. F. A hood covers the quenching bath, and an exhaust duct carries away the steam and fumes. When the shafts have cooled to a temperature of 250 deg. F., they are removed from the quenching bath. They are then put into boiling water for ten minutes to relieve the hardening stresses. Fig. 3 shows a stand for supporting the work which is typical of the facilities for the convenience of the operator used throughout the Ford plant. It shows also the brackets used for holding the camshafts in the overhead monorail conveyor.

The shafts are again straightened and inspected on a Rockwell hardness tester. Specifications call for a hardness of C55 on the Rockwell hardness scale after heat-treatment.

Camshaft bearings are then semi-finish ground simultaneously on a three-wheel centerless grinding machine similar to that illustrated in Fig. 1. The next operation, shown in Fig. 4, is done on a special machine that rough grinds the cams by forming the contour and indexing from one cam to the next automatically. The wheel is trued by a special device after each shaft is completed. Only one wheel is used, and this oscillates across the face of each cam during the cut.

The flange face and the outside diameter is then semi-finished in two grinding operations. The gear seat is rough and finished ground on a standard cylindrical grinding machine. Then the camshafts are straightened preparatory to the final finishing operations.

Finish grinding is done in the same types of machine as the rough grinding operations, and the steps cover practically every surface of the shaft. All burrs are carefully removed and the cam surfaces and bearings are then polished.

The fixture for inspecting for timing is of interest because of the many dimensions involved. A large beveled index wheel is marked for the angular position of each cam, giving the number of the cam and the indicator reading desired. This wheel is rotated until one of the divisions comes opposite a stationary pointer arm. Then the inspector can see from the markings just which cam is to be tested and what its reading should be. Each cam is indicated on the low side at which the reading should be zero. Then two other positions are checked, one at each side at which the indicator should show a rise of 0.015 in.

Fig. 4—A single wheel grinds the contour of each cam successively in a special machine

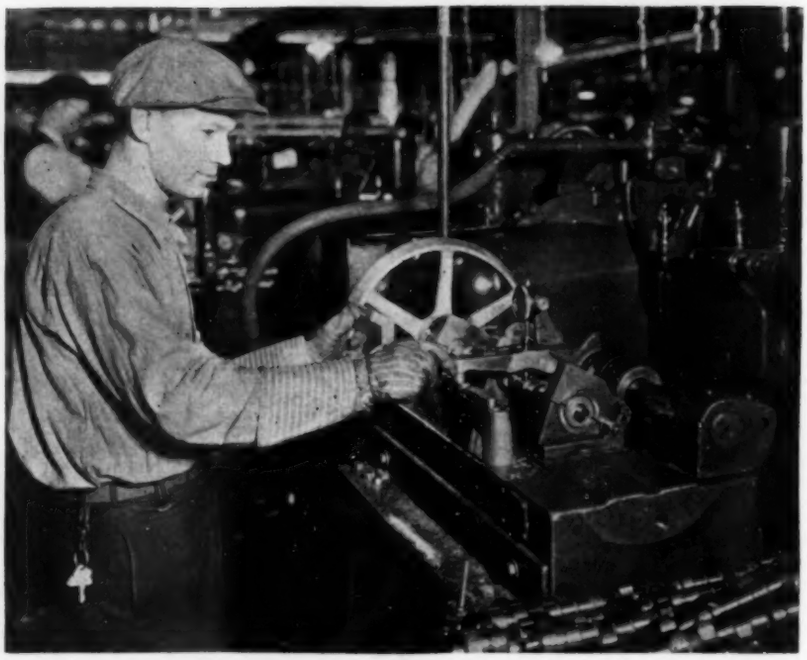


Fig. 5—Timing is checked in an inspection fixture that gives 48 readings on each piece

The limits are plus or minus 0.002 in. for each position.

When the camshaft is put into the fixture, it is mounted in all three bearings and located angularly from the driving groove used in the cam grinding operations. The indicator is mounted on a lever which carries a small ball-pointed plunger, the upper end of which touches the indicator stem. A flat spring holds this plunger against the cam surface. The lever is supported on a large accurately ground arbor at the rear of the fixture and may be raised or lowered or moved lengthwise at will. When in the operating position, a button on its under side contacts with one of sixteen buttons held in the body of the fixture, one for each cam.

The inspection of three positions on each of sixteen cams means that a total of 48 separate readings must be taken on each piece, but an experienced inspector completes a shaft with surprising rapidity.

The manufacture of the V-8 camshaft is just one of many instances found at the Ford plant where high production is combined with precision. Three thousand of these parts may be turned out exery sixteen hours in the set-up described. But few of the drivers of new Fords realize the infinite care that goes into the completion of their motors.

Precision Printing on the Milling Machine

JOHN BROOMFIELD

Supt. of Shops, New York Museum of Science and Industry

The New York Museum of Science and Industry, at 220 East 42d Street, requires labels for its many exhibits. Most of these are simple cards with a little information. These have been standardized and are printed on a 6x9 hand press installed in the Museum shop. In addition to these, there are other exhibits that require large diagrams having printed explanations, and on the walls there are photostats and drawings that call for lettering. For uniformity of appearance, all of these, both large and small, are in the same type. In the large work only one copy is required.

In the past this has been done by hand lettering, which is both slow and expensive. To speed this up and to obtain uniformity and a better looking job, experiments were tried with the view of printing the legends on the drawings. This is not easy as many of these charts and drawings are four feet square with only a few words of lettering which might be located anywhere. To have a press as large as this would be out of the question.

The need has been cared for in a very satisfactory way, using a No. 1 Milwaukee special universal milling machine with the double round bar arbor support. The chase, with its type, is clamped upside down to these bars and the table of the machine is use to support the chart to be printed. A general idea of the set-up is shown herewith.

The block of cast iron *A* about 12 in. square and 2½ in. thick is secured to the arbor support by a clamp plate and a ⅝ in. bolt. The type chase is fastened to the under side of this block. The single bolt allows the chase to be turned at any angle. To locate the card to be printed, the guide *B* is used, this being a wooden straight edge clamped at a suitable height above the surface plate *C*. The adjustable stop *D* slides on *B*.

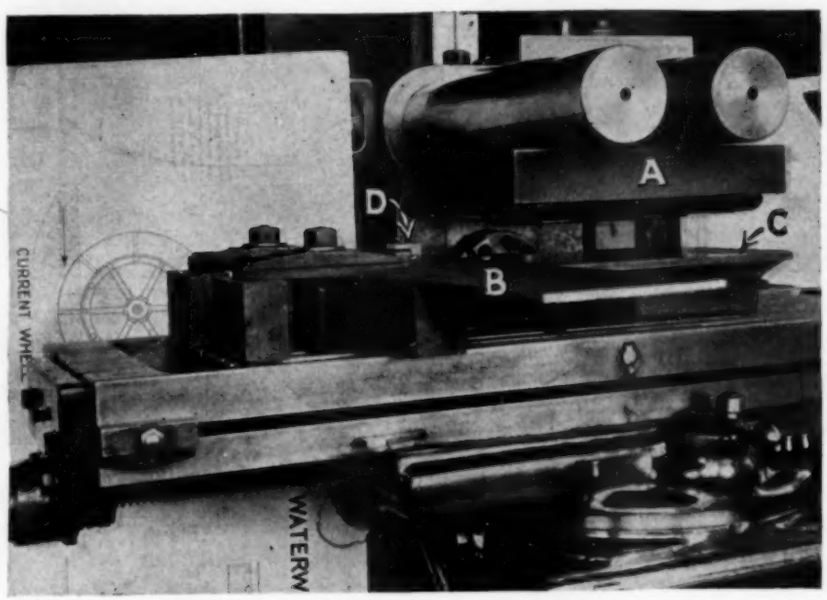
The procedure is first to locate the impression on the drawing, then cut a piece of typewriter or tracing paper about an inch larger on all sides than the block of type. Tracing paper is used when it is desirable to see through it to help in locating. This paper is stuck to the drawing with rubber cement, approximately where the impression is to be. The rubber cement sticks to the paper without affecting the surface, the piece can be peeled off easily and the cement rubbed off with the fingers or a piece of art gum. Having cemented this piece of paper on, pencil lines are drawn on this, locating one side and the top edge of the impression. The type is then roughly lined up with these by eye, using the cross lines. The card is pushed up against the straight edge and stopped. The type is inked by means of a rubber hand roller, and the vertical slides raised until the top just touches the typewriter paper, and then about 0.005 in. more.

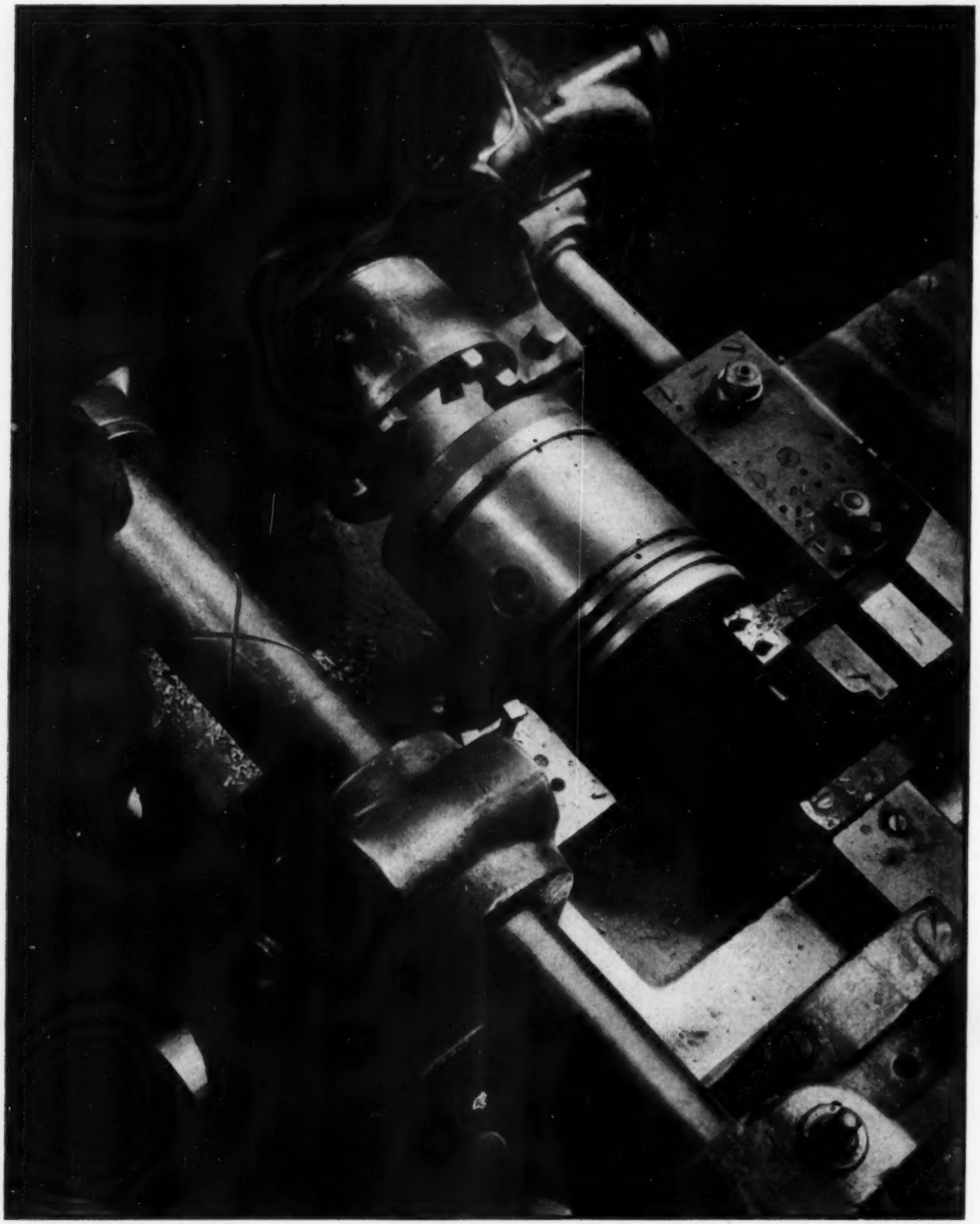
Correct Alignment

If there are slight errors in setting, the slides are moved to bring the type into exact alignment, and the corrected setting checked. It has never been necessary to make more than two trial impressions. The thin paper is then removed and the printing done directly on the drawing.

Sometimes it is found that a perfect impression is not obtained the first time due either to insufficient inking or insufficient pressure, but the set-up is so accurate and rigid that if the cross slides have not been moved, a second impression can be made and will be found to register perfectly. The amount of pressure required is a matter of experiment and depends upon the thickness and nature of the material which is backing the drawing. If this is less than $\frac{1}{32}$ in. a card should be used between the surface plate and the drawing. In general, with 30 sq.in. of type and a card backing approximately ¼ in. thick, the table should be moved up about 0.020 in. after contact with the type.

The illustration also shows part of a large drawing on which suitable legends have been printed. This seems to be a new use for the milling machine.





Courtesy Worthington Pump & Machinery Corp. *Photo by Rittase*

No longer will a single cutting point meet

the production demands of an impatient industry

EDITORIALS

AMERICAN MACHINIST
VOLUME 76 ESTABLISHED 1877 NUMBER 28
McGRAW-HILL PUBLISHING COMPANY, INC.
K. H. CONDIT F. H. COLVIN
EDITORS

On Trial

Bankers and business men, manufacturers and industrial leaders, and all the rest of us whose wellbeing depends on the activity of American business are thoroughly convinced that the period since October, 1929, has been one of trials beyond belief. Yet we are mistaken. The real trial of our courage, our initiative, our capacity, faces us today.

Why? Because industrial recovery has been put squarely up to the banker and the business man by Congress and the Administration. The alibi which has been worked so hard during the last seven months has expired.

For weeks an intensive effort was made to persuade Congress to broaden the powers of the Reconstruction Finance Corporation so that it might extend aid to industry through loans for the purpose of replacing obsolete machinery with up-to-date equipment, thereby not only lowering the cost of the product made on this equipment, but also providing employment for the men who build such equipment. It seemed then that it would be wiser to handle this financing through the Reconstruction Finance Corporation than through the Federal Reserve System. But this provision of the Emergency Relief Bill became so entangled with the Garner plan for loans to everyone, which met the determined opposition of the President, that the whole thing was finally eliminated.

Then Senator Glass introduced his amendment broadening the powers of the Federal Reserve System, and it was passed. It authorizes the Federal Reserve System to make long-term loans direct to borrowers without the mediation of a member bank. It is generally understood that such a provision was included in the original legislation which set up the Federal Reserve System but was knocked out by the determined objections of certain influential bankers.

Generally speaking, the making of loans will not be a new operation for the Federal Reserve System. It has dealt heavily in government securities, in acceptances, and in foreign exchange. All that is dispensed with in the new law is an endorsement by a member bank. In its place some other adequate endorsement and security are required.

Still speaking generally, the uneasiness that has been aroused by the new provision seems to be unwarranted. There are plenty of safeguards in the legislation to prevent the Federal Reserve System from running wild if it were ever tempted to do so. The new type of loan can be made only under emergency conditions. Besides that please remember that the various Federal Reserve Banks are largely in the hands of the leading bankers in their respective districts, through control of directorships.

It would be more logical to dread complete inaction by reason of this very control. But any attempt to emasculate the new power of the system will unquestionably be countered by powerful pressure from the Administration. An election is imminent and the direction of the business trend may well decide it.

Such being the case the ever-present threat that a Federal Reserve Bank will step in and make a direct loan will go very far to reverse the ultra-conservative policies of member banks, many of which are now seeking for uses for their excess reserves. As a matter of fact it is highly probable that the making of direct loans by the Federal Reserve will be the rare exception. The Reserve officials will certainly prefer to have a member bank make the loan, and the ace up the sleeve of the central bank will probably have to be flashed but rarely.

So much for the hard-boiled approach to the new arrangement. It may be necessary to threaten a few stand-pat bankers but the majority of the bankers are just as eager to see business revive as anyone else, and if a group of business leaders to whom we sent letters some weeks ago are to be believed, their local bankers are doing their full share in keeping deserving clients going. We published these comments in *American Machinist*, June 2, 1932.

Specifically, what is the machinery industry going to do with this unparalleled, and somewhat unexpected, opportunity? Based on a rough but conservative estimate, half a billion dollars worth of equipment in metal-working plants is obsolete, and should be replaced. Perhaps fifty million dollars worth of replacement orders has been held up awaiting some reasonable means of financing. Those means are at hand. And probably at least as much more business is held up, not because the money is not available but because those who can release it have been afraid to do so. They would be quick to climb aboard the bandwagon if the others started.

But metal-working machinery is only a small part of the picture. Power plant equipment to perhaps an equal value is out of date. Textile, printing, railroad, coal mining equipment that sadly needs replacement might account for a billion or more. Other industries are handicapped by their respective loads of out-of-date machinery.

Whether the terms of the Glass Amendment are carried out literally, or whether some other means of conducting the financing are devised is immaterial. Possibly it will be found wise to set up a new financing

corporation, or a series of such corporations in the respective Federal Reserve Districts. Or some way may be discovered to bring the Reconstruction Finance Corporation into the picture. The vital thing is that Washington has opened the door to financial aid for employment-making capital expenditures by industry —self-liquidating in the broadest sense of the term, so far as modernization of equipment is concerned—and it is up to industry to cooperate with finance and with government to make the money go as far as possible.

Congress has given the necessary power to the Federal Reserve Board, but in spite of this legislative authorization the conservative members of the Board may decide that it is not orthodox banking policy to grant loans for such capital expenditures as equipment modernization. If they do so decide, some other financial machinery must be set up to accomplish the same purpose. In any event the responsibility for action lies with industry, for the bankers are not likely to force loans on reluctant borrowers. Modernization of equipment is the quickest way to set the wheels to turning. Industry alone understands that basic principle and must therefore interpret it to finance. Industry is on trial.

• CHIPS •

Congress adjourns and we all heave a sigh of relief . . . accomplishments rather disappointing on the constructive side but far less damaging on the destructive side than had been feared . . . Dispassionate estimate of total result of Congressional and Administration achievement is that basic difficulties were carefully sidestepped but that temporary relief measures were fairly well handled . . . which means that a big job faces the next Congress . . . and the next President.

U. S. and Canada sign treaty for St. Lawrence development . . . biggest construction project on North American continent . . . Must be ratified by legislative bodies . . . will lead to employment for thousands and may revolutionize transportation to the Middle West . . . U. S. Reclamation Service awards ten million contract for Hoover Dam welded pipe to Babcock & Wilcox.

Four-system grouping of Eastern railroads approved by I.C.C. . . . Wall Street favorable, railway labor opposed, Pennsylvania officials mum . . . Western roads still looking for czar . . . Sir Henry Thornton retires from C.N.R. and is mentioned for post.

Hoover directs Commerce and Labor Departments to survey progress of adoption of five-day week in industry . . . meets with New England leaders to discuss Davis plan of unemployment relief through job rotation . . . plans to put full force of Administrative effort behind favorable indicators to stimulate general recovery . . . Sub-Committee of the Young Committee of industrial and banking leaders asks National Industrial Conference Board to find out experience of large and small corporations in attempts to obtain needed credit accommodations . . . Campaign to broaden use of trade acceptance gathers strength as such companies as DuPont, G.E., Westinghouse, Pittsburgh Plate Glass, U. S. Rubber get behind it.

Lausanne Conference ends in agreement that means end of reparations . . . Results, discounted at first, now look more important . . . Geneva does not achieve disarmament but indicates growth of sane attitude when so many nations can talk about it for months without getting too excited . . . Borah comes out for world economic and monetary conference in spirit of Lausanne agreement . . . British Empire Conference may dislocate some of our trade.

Chile nitrate dumping threat not taken too seriously . . . Attempt to stop futures trading on Chicago Board of Trade has a slight political odor . . . Canners Supply Corp. moves to put canner in can business by offering can parts and machines to assemble them . . . Lead buying spurts . . . Other base metals moving into consumption channels . . . Manufacturers of household machinery rushing development of new lines . . . Launching of many projects will depend on upswing of business curve . . . Refinancing of about $100,000,000 public utility bonds cheers utility industry . . . Power consumption figures appear to have become stabilized . . . Two $8,000,000 orders placed recently taken as favorable signs . . . Power plant equipment manufacturers have some orders for modernization of plant . . . know of many more and expect releases soon . . . Liquidation of textile plants continues but sentiment is improved and material prices are stiffening . . . parts business is better . . . indication of plant overhauling and probable future machinery orders . . . used machinery selling well . . . Construction curves rising slowly . . . $600,000 street railway rehabilitation plan in Indianapolis

Gulf States Steel mills at Gadsden, Ala., resume . . . India Tire & Rubber, running six hours a day, seven days a week, restores twenty per cent cut made in January . . . New England joint reemployment conference asks Hoover to call national conference on Davis plan for shorter and more flexible work day and week . . . A.F.L. demands five-day week . . . would be boon to those working two days or less . . . Cleveland Reserve Bank insists big business awaits release of credit . . . Carnegie Steel places big scrap order . . . hailed as favorable sign for better steel business in fall . . . Norwood plant of Remington-Rand, on full time for past six months, puts on night shift . . . Stewart-Warner adds to force.

Many Companies Approve Trade Acceptances

Following announcement of indorsement of trade acceptances by the Young committee of bankers and industrialists (*AM*—Vol. 76, page 828c), the National Electrical Manufacturers Association reports a list of companies that approve the plan despite their own strong position and are also urging its adoption by their responsible customers. These companies follow:

American Rolling Mill Company
American Smelting & Refining Company
Campbell Soup Company
Chicago & Northwestern Railway
E. I. Du Pont de Nemours & Company
Freedom Oil Works
General American Tank Car Corporation
General Electric Company
General Motors Corporation
Harbison-Walker Refractory Company
Hubbard & Company
National Steel Corporation
Pittsburgh Plate Glass Company
Standard Oil Company of New Jersey
The Superheater Company
United Engineering & Foundry Company
United States Rubber Company
Westinghouse Electric and Manufacturing Company

Briefly, trade acceptances constitute the substitution of trade bills for open book accounts. Their use would make available to business in every section of the country and to concerns of moderate size the congested credit supply in the large center banks. Accompanying the invoice, or the statement for purchases over a given period, the trade acceptance would be signed in lieu of cash payment and returned to the seller. The seller may hold it and forward through the banks for collection at maturity, or he may discount with his banker or sell in the open market, thus converting into available live assets the frozen capital, practically unavailable, hitherto tied up in book accounts. Thus, it can be seen that a trade acceptance is a time draft by a seller of goods upon the buyer thereof for the purchase price and accepted by the buyer with his promise to pay at a specified time and place.

From the banking standpoint, a trade acceptance represents the best grade of two-name commercial paper, self-liquidating, and eligible for rediscount at or purchase by the Federal Reserve Banks. Until the present, the commercial banks have found it easier to extend credit on three or four notes than to discount and collect perhaps thirty or forty trade acceptances totaling the same amount. But the banking world is becoming convinced that two-name commercial paper bearing on its face the evidence of the buying and selling of goods stands in the front rank as a highly desirable form of employment for loanable funds. In time we shall probably see practically all of our domestic trade carried on through this medium.

Summarizing, the advantages to the seller are as follows:

1. Liquid commercial paper is substituted for open book accounts, the capital for which is tied up until maturity and generally longer.

2. This paper is in most acceptable form for discount or sale. It is favored by the Federal Reserve over other types of obligation and makes the resources of the Federal Reserve available for the proper conservative operations of the responsible merchant or manufacturer however small.

3. The cost of accommodation should be lower than that obtained by direct borrowing.

4. Payment is made in accordance with the terms agreed.

5. There is added incentive to care in extension of credit and added knowledge available for determining credit.

The advantages to the buyer are:

1. Those who settle by trade acceptance will be in practically the same preferred class as those who discount for cash.

2. The need for promptly meeting obligations when due will tend to check overbuying and will induce better collection methods.

3. The established credit standing will enable purchase on the more favorable basis, permitting better competition with cash buyers.

4. The established credit standing will make available the whole field of producers rather than confining him, as is frequently the case, to a few.

With both seller and buyer lies the advantage that business is done at lower cost, permitting lower prices to the consumer.

U. K. Admits Certain Machinery Duty Free

Machinery of certain specified types will be admitted duty free into the United Kingdom if the Import Duties Advisory Committee is satisfied that similar machinery is not immediately procurable there. The specified types of machinery are: Machine tools and woodworking machinery; agricultural and dairy machinery; sugar making machinery; textile machinery; glass making and working machinery; chemical and soap making machinery; weighing, packing and filling machinery; and paper making machinery.

In practice, importers of machinery that meets this requirement are expediting business by getting the purchaser to make the required application to the Import Duties Advisory Committee. The Committee has also announced that it may add to or take from the approved list any item, at any time, whenever such action is approved by the Treasury.

• INDUSTRIAL REVIEW •

The feeling of optimism that was born in the machinery industry several weeks ago is growing apace, and has more reason for existence. While orders for new machinery are extremely scarce there has been some improvement in used machinery business and inquiries look decidedly more substantial. Operations in many metal-working plants and shops are on the mend and furloughed employees have been recalled. Hopes for September and October orders are high.

Chicago reports decidedly heightened activity in job and contract shops and takes this as a sign of general improvement to follow. In Cincinnati there is little in the way of tangible orders to account for better sentiment there but a few machines have been sold. The automobile plants of Detroit are still feeling their way rather cautiously although it is generally believed that the turn has come.

Rumors of the early placing of roll business in Pittsburgh are taken as omens of increase in steel mill activity. A few scattering orders for machine tools have been placed. Philadelphia has no machinery business on which to base its better sentiment. Boston machinery men are encouraged by the starting up of textile mills and shoe and leather plants. They look for orders, possibly by September.

Milwaukee looks for little machinery business before September or October but says that salesmen's reports are sounding a far more optimistic note than for some time past. In St. Louis industrial corporations are concentrating vacations in the expected dull weeks of August. Sentiment is greatly improved there as elsewhere.

A.S.M.E. Nominations for 1933

The nominating committee of The American Society of Mechanical Engineers has presented the names of its candidates for office for 1933. Nominations are as follows: A. A. POTTER, dean of the schools of engineering, Purdue University, for president; J. D. CUNNINGHAM, president of the Republic Flow Meters Co., Chicago, Ill., vice-president, H. V. COES, manager of the industrial department of Ford, Bacon & Davis, Inc., New York, vice-president; C. E. HIRSHFELD, chief of research department, Detroit Edison Co., vice-president; R. L. SACKETT, dean of the school of engineering, Pennsylvania State College, for manager; J. A. HUNTER, professor of mechanical engineering, University of Colorado, for manager; and Alex D. Bailey, superintendent of generating stations, Commonwealth Edison Co., for manager.

• BUSINESS ITEMS •

American Shim Steel Co. has been organized in New Kensington, Pa., for the purpose of manufacturing and distributing shim steel to railroads and machinery builders. The company will occupy the property used by the Kenney Machine Co. C. THOMAS BEST is president.

Bryant Machinery & Engineering Co., 400 West Madison St., Chicago, Ill., has announced the appointment of various agents to represent it for the various lines of machine tools distributed. The agents are as follows: G. A. RICHEY, Room 609, Chamber of Commerce Bldg., Indianapolis, Indiana, agent for the Indianapolis territory; THOMAS M. REES, 18 Fancourt St., Pittsburgh; D. E. DONY, 1115 Bay St., Rochester, N. Y., and the A. L. Bechtel Machinery Co., 2848 Woodbury Road, Shaker Heights, Cleveland, Ohio.

The Grilley & Haven Mfg. Co., Bridgeport, Conn., a new company, has leased floor space in the plant of the Remington Arms Co. and will specialize in the manufacture of brass form blanks. CHARLES E. GRILLEY, president, was formerly chief engineer for the Waterbury Brass Co.

Garrison Machine Works, Inc., gear chuck manufacturer, Dayton, Ohio, has moved its offices and factory to the Norwood Power Bldg., same city.

The machine shops of the Chesapeake & Ohio at Peru, Ind., have been reopened after a suspension since March.

Norton Company, Worcester, Mass., has acquired the entire common stock of the Pike Manufacturing Co., Pike, New Hampshire, and the new unit will be incorporated under the name of Norton Pike Co. with main office at Worcester. Executives offices will be continued at Pike, New Hampshire, and manufacturing operations will be conducted exclusively at Pike and Littleton, New Hampshire. Officers will be HERBERT E. SMITH, president; W. LA COSTE NEILSON, vice-president; GEORGE N. JEPPSON, treasurer; and CLIFFORD S. ANDERSON, secretary and clerk. The Pike Manufacturing Co. was established in 1823 as a result of a discovery in the vicinity of a natural abrasive rock suitable for sharpening tools.

Stephens-Adamson Mfg. Co., conveyor manufacturers, Aurora, Ill., have established a branch office at Rochester, at the Cutler Bldg. F. H. WISEWELL, Rochester engineer, has been appointed district manager and will be in charge of sales and engineering.

Worthington Pump & Machinery Corp. has announced the decision to transfer and consolidate the designing, engineering and manufacturing activities formerly carried on at its Cincinnati works with those of the Buffalo manufacturing plant. For the present the Cincinnati plant equipment will remain intact, and the Cincinnati district sales office will continue under the management of EARL VINNEDGE.

• PERSONALS •

ALFRED E. BALLIN has been made vice-president in charge of engineering by the Nordberg Mfg. Co., Milwaukee, builders of Diesel and steam engines and other heavy machinery.

E. C. BRANDT, assistant works manager, Westinghouse Electric & Mfg. Co., East Pittsburgh, has been appointed manager of renewal parts in all Westinghouse plants.

JOHN R. CASSELL, who has been associated with the Charles Bruning Co., is entering the field of drawing, tracing and detail papers, by the establishment of such a department within the organigation of the National Consumers Paper Corp., New York. Mr. Cassell is manager of this department.

A. H. GFROERER, chief engineer for the last 13 years of the Automatic Transportation Co., Chicago, and also chief engineer of the Barrett Cravens Co., Chicago, for the last 3 years, retired at the end of June. He had been connected with the material-handling industry since 1910.

GEORGE B. INGERSOLL has resigned as chief engineer of the Federal Motor Truck Co., Detroit, and will devote his time to law practice relating to patents and trademarks. His office will be at 1420 David Stott Building, Detroit.

CARL M. KALTWASSER has been elected president and general manager of the Watson Mfg. Co., which has taken over the business of the Watson Metal Specialty Co., Jamestown, N. Y. WILLIAM W. WATSON, was made secretary and treasurer.

HERBERT P. LADDS, manager of sales, Lamson & Sessions Co., Cleveland, has been appointed vice-president and general manager of the Lamson & Sessions Bolt Co., Birmingham. He succeeds FRED H. MOHNS, who retires.

ROBERT K. PLUMMER, formerly assistant sales manager of Gears & Forgings, Inc., Cleveland, has joined the sales staff of the Perkins Machine & Gear Co., Springfield, Mass. Mr. Plummer will represent the company in the Cleveland and Chicago territories.

WILLIAM B. MAYO, chief engineer of the Ford Motor Co. and engineer in charge of the aviation activities of the Ford Company, will retire from the company's service on Sept. 1. Mr. Mayo has been with the company for 20 years.

ERNEST VON MERTENS, formerly engineer of the Scintilla Magnetic Corp., Sidney, N. Y., assumed duties recently as engineer on production and development with the Groove Pin Corp., Long Island City, N. Y.

RAY A. MILLHOLLAND has resigned as vice-president and director of the Millholland Corp., Indianapolis, Ind. His residence is 5157 Winthrop Ave., Indianapolis.

WILLIAM A. RAMMING, JR., was recently elected to the office of secretary of the John Ramming Machine Co., St. Louis. He was previously connected with the Busch-Sulzer Bros. Diesel Engine Co. of that city.

GEORGE A. PAGE, JR., until recently design engineer of the Curtiss Aeroplane & Motor Co., Buffalo, has been appointed chief engineer of the Curtiss-Wright Airplane Mfg. Co., Robertson, Mo.

H. J. RITTER, assistant secretary of the Norma-Hoffman Bearings Corp., Stamford, Conn., has been made sales manager as well.

C. H. Roth, who was president of the Roth Bros. & Co. division of the Century Electric Co., of St. Louis, was recently elected president of the Light Sensitive Apparatus Corp., Niles Center, Ill., manufacturers of oil testers, smoke recorders and other apparatus.

Harold F. Schwedes, formerly tool designer for the American Airplane & Engine Corp., Farmingdale, N. Y., has joined the Berliner Joyce Aircraft Corp., Baltimore, in a similar capacity.

Wirt S. Scott, special representative of the Westinghouse Electric & Mfg. Co., Mansfield, Ohio, was recently awarded a professional degree of electrical engineering by the Ohio State University in recognition of his position as a leading authority in connection with the economic study and application of electric heating for industrial and commercial processes, and as technical writer and lecturer. Mr. Scott is author of the article "Tests Show Wide Variations Inside Heat-Treating Furnaces," on page 898 of this number.

Perry L. Tenney, who resigned as chief engineer of the Muncie Products Division of the Central Motors Corp., has entered the service of the Olds Motor Works, Lansing, Mich., in the capacity of engineer in the transmission division.

A. W. Thompson, vice-president in charge of manufacturing, Fairbanks, Morse & Co., Beloit, Wis., resigned July 1 and has been succeeded as general manager by Alan E. Ashcraft. Mr. Ashcraft has been in charge of the scale works at St. Johnsbury, Vt.

V. S. Veenman has been appointed foundry superintendent for the France Foundry & Machine Co., Toledo, in charge of jobbing and production bronze and aluminum castings.

E. R. Wegener has resigned as president and general manager of the Detroit Forging Co. Previously he was attached to the steel buying division, Ford Motor Co.

Earl W. Winans has been appointed chief engineer of the Federal Motor Truck Co. His appointment, as just announced by M. L. Pulcher, president of the Federal company, follows the resignation of George B. Ingersoll, who formerly held this position.

John G. Wood, has been appointed chief engineer of the Olds Motor Works, Lansing, Mich. He was formerly connected with the Muncie Products Division of General Motors, of which he was general manager.

• OBITUARIES •

Fred L. Andrews, vice-president and general manager of Hyde Windlass Co., Bath, Me., died July 13. Mr. Andrews had been general manager of the company since 1905 and was considered an expert in the manufacture of propellers and marine machinery.

Roy C. Blanchard, 40, production engineer of the grinding machine division of the Norton Co., Worcester, Mass., died recently following an operation. He had been with the company for 16 years. Mr. Blanchard was author of the Norton prize winning brief in the *American Machinist* replacement-policy award series.

F. S. Duesenberg, Indianapolis auto manufacturer and sportsman, died July 26 at Johnstown, Pa., as a result of injuries received on July 2, when his automobile overturned. Although Mr. Duesenberg lacked technical training he exerted a profound influence in the engineering development of the motor car.

F. S. Duesenberg

He was credited with the introduction in this country of the eight-cylinder car and of the four-wheel brake. At the time of his death he was the vice-president of Duesenberg, Inc., of Indianapolis, a subsidiary of the Cord Corp.

Frederick J. Greene, inventor and manufacturer of Racine, Wis., died recently at the age of 63. He was the founder and president of the F. J. Greene Engineering Works, F. J. Greene Mfg. Co., Christensen Machine Co., and Ideal Stitcher & Mfg. Co.

Edwin Beard Hendrie, manufacturer, designer and distributor of mining, harvesting, railroad shop and other types of machinery, died July 15, at Denver. In 1880 he joined the firm of Hendrie Bros. and Bolthoff, at Central City, Denver, and later moved it to Denver. From 1890 until his retirement in 1930, Mr. Hendrie was president of the firm.

James McWilliams, vice-president and treasurer of The Watson Machine Co., Paterson, N. J., died on July 21. Recently he observed his 50th anniversary with the company.

M. B. Muxen, 50, president of the Tokheim Oil Tank & Pump Co., Fort Wayne, Ind., died recently. He had been president of the company about four years and also was chairman of the board of directors of the Kelly-Springfield Tire Co.

Edward P. Schramm, founder of the Syracuse Chilled Die & Casting Co., Syracuse, N. Y., and president of the Hohen-Scheid Heat Treating Co., Detroit, died recently.

William Strube, 55, president of the Strube Screw Machine Works, Chicago, was killed recently by the explosion of an air bomb at the laboratory of his plant.

Henry Lyles Zabriskie, chief engineer of the Diehl Manufacturing Co., Elizabethport, N. J., died on July 10. He joined the Diehl Co. in 1903 as chief engineer and occupied that position until the time of his death. He was one of the pioneers in the electrification of home-type and industrial-type sewing machines.

• MEETINGS •

American Society of Mechanical Engineers. National Machine Shop Practice Meeting, Buffalo. Week of Oct. 3. Calvin W. Rice, secretary, 29 W. 39th St., New York, N. Y.

National Metal Congress & Exposition. 174h Regiment Armary, Buffalo, N. Y., Oct. 3-7. Sponsored by A.S.S.T., with cooperation of A.S.M.E., Institute of Metals and Iron & Steel Divisions of A.I.M.E., A.W.S., S.A.E. and the Wire Association. W. H. Eisenmann, 7016 Euclid Ave., Cleveland, Director.

Society of Automotive Engineers. Aeronautic meeting, Hotel Statler, Cleveland, Aug. 30-31. Production meeting, 174th Regiment Armory, Buffalo. Week of Oct. 3. John A. C. Warner, secretary, 29 West 39th St., New York, N. Y.

Cutting Loose

"Well, Ed, I'm getting through this week end."

"Yeah, I heard some of your boys talking about a supper or something. Gosh, Al, I can't tell you how it takes the heart out of me. Half the joy in this job has been association with you."

"Thanks, Ed. I appreciate what you say. I feel bad, too, but I'm not going to leave town and you can bet that I'm not going to let it affect our friendship. I need friends more than ever and am going to hang on to those I have. And say, Ed, kill that supper idea, will you, and any talk of a present. The boys can't afford it, and they don't owe me a thing. I should be giving them a supper, but I can't afford it, either."

"Sure, I'll do what I can, Al, and speaking of friendships and eating, I'll tell you what let's do; let's have lunch together now and then. What d'you say? Can you arrange it?"

"Sure I can, and I'll be mighty glad to do it. I get a lot of good ideas from my talks with you. Let's say we'll meet every other Wednesday. How's that?"

"Fine. That's settled. To change the subject, what did Williams say?"

"Oh, he wasn't surprised, because I had been talking to him about the proposition. He said he wished he had as much courage as I had. He even hinted strongly that he'd put in some money if Mason and I'd invite him to."

"Fine, but does that mean that Williams is thinking of leaving? If he is, I might as well quit, too."

"No, I don't think Williams will quit. I discouraged his idea of investing money, too."

"Why? He's a mighty good friend of yours, and I should think you'd want all the money you can get. Why don't you want him in; Mason object?"

"No, indeed. But we may want some tool work from Williams. If he was a member of the firm, he wouldn't give it to us. We may want to buy some of those old machines you are always kicking about, too. No, he's more useful to us without a financial interest. Williams is so straight that he'd never give us any work or sell us any machines if he was interested with us. I appreciate his willingness, however."

"That's all bosh, Al. As you say, Williams is square. The old man knows he's honest and wouldn't criticise no matter what Williams did. Why shouldn't he give you some tool work? And why shouldn't you get a few old machines that should have gone to the boneyard long ago? You've done a lot for the company, and the mere fact that Williams has put some money into your enterprise doesn't mean a thing."

"A lot of honest men think it does, Ed. Possibly in some cases it doesn't matter, but Williams and I are of the same mind on it. If the time ever comes when we don't need assistance of any kind from the company, we'll be mighty glad to have Williams' money, or Williams himself. But no man can serve two masters."

"Gosh, Al, I'd hate to have to live with a conscience like yours. It must keep you tossing and turning most of the night."

"We all have queer notions of right and wrong, Ed. Like you throwing back a fish a half inch under legal size. To me, that fish would taste just as good as one half an inch longer."

"Oh, but that's different. That was a case of being a good sport. It didn't cost me anything."

"Sure. So's this different, and it won't cost me anything in the long run."

Is Al justified in looking to his old firm for work? Is his stand on not accepting money from Williams a little over conscientious?

Discussion

Is This a Good Time to Quit?

A successful foreman is justified in quitting a good job at the present time for a problematic better future only if, besides being well acquainted with the fundamentals of good business, he is financially able to rough it for quite a while. Momentary dissatisfaction of present position shouldn't be allowed to cause anyone to enter upon so great an adventure with little or no planning.

In most cases, the sudden determination to enter into business for oneself is a fever which gets the majority of us at times and generally may be cured by a good night's sleep. But to a serious-minded foreman, who has given the idea his most earnest attention by thoughtful planning and whose financial status warrants his entrance into the business world, my advice is—go ahead and good luck

BEN SCHLAFER.

Has Al stopped to think of the many other successful foremen in the country who have at times become discouraged with their duties and uncertain future? He certainly is not all alone in this class, but most of these men have decided after careful consideration to stick to the job.

To become a successful foreman, a man must have the background of several years' training in whatever business

his employer is engaged. When this training has been completed, the employer naturally expects some return for the expenditure incidental to this training. If this is true, would it not be just for Al to consider along with other things a sense of loyalty? A good soldier does not run when things get hot on the firing line.

Al, by all means hang on until such a time as you will be doing a justice to both yourself and your employer by leaving when business conditions are good. Then go to your employer, tell him your business plans and try to do this far enough in advance so that your successor can spend some time with you in the department learning the job before you leave. After all, some time you may want to return, and with a clean bill of health, your chances in this respect would seem to be much better.

—Harry J. Salisbury,
Aluminum Cooking Utensil Company.

There is a manufacturer of knit goods within a mile of my desk that can count a dozen offshoots within another mile; all the result of layoffs. On the other hand, I have watched many machine tool men break away, fit up a little shop and buck their former employers, usually for a total loss. Why? Because it requires more capital than such men usually have to get started, and it takes still more to get going. A man cannot build one lathe and go out and sell it for more than second-hand price. Dealers want established and well-known lines.

The one exception to this rule was at the outbreak of the World War, when a few men hit it right, unwittingly, and started little shops just in time to catch the low price of equipment and then saw orders thrust at them. They made money, not by virtue of any ability of theirs but by force of circumstances. If they sold out just at the peak, they pass today for astute business men and are called on to tell the world how to get out of the depression.

—E. H. Fish.

No Admittance

When factory executives exchange ideas on manufacturing methods, the outcome generally paves the way for better quality in the article or for cheaper production methods. In the long run, it is the buying public who benefit to the greatest extent; but how about the manufacturer? He spends thousands of dollars annually developing equipment and methods and the exclusive right most certainly belongs to the organization which risks its capital to finance progressive policies.

It would seem that the good old-fashioned system of secret development of ideas with adequate patent protection, then inspection by outsiders followed by royalties and leases to allied manufacturers who are able to cash in by their adaption, works out to mutual advantage both to the originator and to the buying public. By all means, let us exchange ideas but only under a system which can financially assure the inventor his priority rights!

—H. R. Polleys,
Development Engineer.

No Questions Asked

A man came to the consulting engineering firm, of which I was manager, with a set of blue prints for a new large stationary vacuum cleaner. It was quite a complicated affair, and as I pointed out to him, was outside our territory. The inventor, an old customer of ours, explained that he did not want a consultation but wanted us to take charge of the manufacturing of the first model. All the plans were complete and our job was to take charge of the blueprints, follow the building of the machine and check up the work.

We knew absolutely nothing about vacuum cleaners. Our first move was to request the best machine shop to

quote on making the experimental model according to the blue prints. This shop was experienced in devices of this kind and replied that while they appreciated the inquiry they did not wish to quote until they had informed us that a few months before they had done experimental work of a somewhat similar type for one of their customers. The results had not been satisfactory and the customer had finally abandoned the model.

We immediately called up the inventor and read the letter to him and asked him if he had any comments to make. He replied that he intended to stick to his design and that he also appreciated the spirit of the letter. We gave the machine shop the contract, and it built an excellent model which, however, did not prove a success and finally was abandoned for a much simpler design.

At no time did we or the inventor feel that the machine shop had done anything but give us an absolutely square deal. The same shop got the order to build all the subsequent models.

—George P. Pearce,
Managing Engineer.

Old Man Opportunity

Men who are alert and ambitious should be given any reasonable opportunity to advance themselves. This is especially applicable to the younger set of employees.

In depressed times, it would be an unwise policy to permit men who have been temporarily laid off to come in and work "on their own hook" for the purpose of learning a trade. Such a privilege would create friction. In practically every community, there are vocational schools, and those that I am familiar with, offer an open door to the unemployed so that they may utilize their spare time for training.

—Peter L. Budwitz.

Control by Council

Any steps that are taken to ascertain the cause of trade depressions are for the good of trade in general and should be encouraged even though the findings are meagre. The work of an economist compiling statistics is difficult because of a strong disinclination to disclose business position on the part of manufacturers. A council, sponsored and financed by the government, with legislative powers to enforce its commands would prove disastrous. Chaos would result because of manufacturers devising means to evade laws which would not meet with general approval. Any remedy advocated, no matter how nearly correct, could not be applied indiscriminately to all manufacturers.

The most progressive solution is to establish an Institute of Trade Fluctuations with a council of an equal number of competent economists, not government officials, and business men. The expenses incurred by this council would be defrayed by membership fees of interested manufacturers, the amount of the fee varying according to the volume of business done by each firm. Best of all would be an international council for the study of the causes of depressions under the auspices of the League of Nations.

—Ronald L. Tandy,
Newark-on-Trent, England

Overloaded

Is it logical to pay for loading only? The answer is, it not only pays, but is being done successfully in many of our larger manufactories. For the manufacturer whose product is constantly changing and being made in small lots, it has yet to prove successful, for it requires more bookkeeping than there are savings made.

Naturally there are "bugs" in such a

plan, both from the employee and employer standpoint. These can be ironed out with a little work and thought, but cannot be generalized, for like many other subjects on scientific production, the bugs vary with the shop and type of product made. No two shops will have the self-same problems, therefore one must try the method, bump himself and learn.

—Charles R. Whitehouse,
Standards Engineer,
Holtzer-Cabot Electric Corporation

How Much Economics?

In this day of rapidly changing business conditions and methods, the educational requirements for successful foremanship must progress also. I believe the shop executive would be well advised to add to his kit of shop subjects, at least an elementary grounding in economics.

By doing so, he is sure to broaden his mental horizon and acquire the habit of thinking beyond the confines which constitute his place in the production plan. Management and the problems attached thereto, then assume a more familiar aspect, and he is able to visualize the cost department not as a necessary evil, but as a unit cooperating with his own department for a mutual aim.

While many of the larger corporations include economics in their foremanship classes, the smaller concern can achieve the same result by adding a few of the modern textbooks on this subject to the shop library. In this connection, it must not be forgotten that business magazines, play an important part in presenting the latest trends and practice in applying the thory of economics.

—Robert S. Alexander.

Traffic Congestion

In the days before the war, we had assistant superintendents or assistant engineers who carried on planning functions. Then, it was possible to disrupt the production line for a new, or a repair part by having the superintendent OK the work slip. It was also possible for the foreman to put the work off for a few days until a lull came in some part of the regular production line, and the extra work could be slipped in.

Today, because of the powers conferred on the production department it is possible to disrupt the line of production and the foreman has no power to prevent it. Later, when the cost is computed, the production department always has records to prove their point, and the shop foreman must stand the blame.

In 1929, one firm, in checking up, found that a part, worth some $50, that has been machined on a verbal order, had actually cost the firm seven hundred dollars by disrupting the production line. Another part, for the experimental department, actually cost three hundred dollars, and it was not used, because of a change the president asked for, even before it was machined.

Had the rule been that no part could go through the production line, without the approval of the superintendent, and the foreman allowed some latitude in the selection of the time and machine, the cost of the extra work would be reduced and entiries in red ink stopped.

—C. G. Williams.

Rolling Stones

Although specialized training for junior executives has many advantages, there is no school like experience, and that can only be limited when all the time is spent in one plant. In these days of depression, the majority of young men have not the courage to leave the plant of their boyhood for a few years

to gain more experience. Those who have sufficient initiative to do so are usually genuinely seeking knowledge of procedure in other factories and districts. These are the men who should be appreciated.

Companies should make it a rule to give no special training for prospective executives unless they have spent at least two years at another plant, preferably in another district where methods and environment are diffierent. Men with good education on completing their apprenticeship and showing good promise of executive ability should be encouraged to go away and get broader experience.

—Alfred Layzell.

Iron and Gold

The foundry should be charged only those costs which it would incur were it run with the same degree of efficiency as an entirely separate concern. Only then can comparisons with outside foundry prices be made justly, and true guidance derived therefrom.

Engineering, pattern, and development costs, that it would not incur as a separate company, should not be charged to it. They should be charged to those departments that would have to bear them if the foundry were independent.

The distribution of the cost of stock patterns over a term of years can be done without charging them to the foundry. While it is all one company, it is also essential to the best management that costs should be equably charged, so they may reveal opportunities for saving and increase of efficiency.

—J. J. Woffington,
Kidderminster, England.

Hand to Mouth

Small lots can be made to pay if the work at all lends itself, and firms lay themselves out for it. The writer is with a firm manufacturing as great a variety of engineering products as any in England. Quantities vary from one to thousands, and prices from a shilling to hundreds of pounds. Nothing in our line is refused, and if not in stock, can be produced in a few hours. An endeavor is made to keep a number of the smaller products in stock, and these can be quickly augmented if required.

Our work entails casting, machining, fitting, testing, and painting. We do not always wait for orders, but get ready for them where possible. The writer is almost constantly engaged converting or adapting appliances for quick change of production, and everything being made interchangeable, little work is necessary when alterations are required.

—William Bryce,
Tinsley, England

Itemized Pricing

Not so many years ago, when a customer purchased a manufactured article, he had to trust to luck that he was getting a "good egg." Nowadays, however, he is covered from six months to five years by a guarantee against faulty material and workmanship and furthermore is rendered free service. The casual thinking layman may think this an admirable state of affairs, but quite obviously nothing is given free, and therefore, the careful user must pay the price of the fool.

Customers as a class believe in getting the last cent from their guarantee. Naturally manufacturers have to cover themselves. Thus it is that a certain proportion of the retail cost takes care of possible service contingencies.

The increased tendency to guarantee service is definitely in the wrong direction. It would be far better to curtail this, spend a fraction of the money on more inspection, and deduct the remainder from the sales figure.

—R. H. Ure,
East Putney, England

American Machinist
Reference Book Sheet

Tap Drill Sizes

Number of Screw	Threads per In.	Size of Screw in Decimals	Body Drill	Body Drill for Interchangeable Manufacture	Size or Number of Drill for Per Cent of full Thread						Monel High Speed	Bronze, Tool Steel, Drop Forg. Stainless Nickel Steel, Copper, Cast Steel	Mild Steel, Aluminum, Cast Iron, Cast Brass	Sheet Brass, Sheet Nickel, Duralumin, Fibre, Babbitt, White Metal, Hard Rubber
					100 Per Cent	80 Per Cent	75 Per Cent	70 Per Cent	60 Per Cent	50 Per Cent	50–60 Per Cent	60–70 Per Cent	70–75 Per Cent	75–80 Per Cent
0	80	.0578	#52	#51	#58	#57	#56	#56	3/64	3/64	3/64	#56	#56	#57
1	64	.0710	48	46	55	54	54	54	#53	#53	#53	54	54	54
1	72	.0710	48	46	55	54	54	54	53	1/16	53	54	54	54
2	56	.0842	43	42	53	52	51	51	50	49	50	51	51	52
2	64	.0842	43	42	52	51	50	50	49	49	49	50	50	51
3	48	.0973	38	36	50	48	48	47	46	45	46	47	48	48
3	56	.0973	38	36	49	47	47	46	45	44	45	46	47	47
4	36	.1105	32	31	49	46	45	44	43	42	43	44	45	46
4	40	.1105	32	31	47	45	44	44	43	42	43	44	44	45
5	40	.1236	30	29	42	40	39	38	37	36	37	38	39	40
6	32	.1368	27	26	41	37	36	35	33	32	33	35	36	37
6	36	.1368	27	26	39	36	35	34	33	32	33	34	35	36
6	40	.1368	27	26	37	35	34	33	32	31	32	33	34	35
7	32	.1500	22	20	35	32	31	31	30	30	30	31	31	32
8	32	.1631	18	17	31	30	30	29	28	27	28	29	30	30
8	36	.1631	18	17	30	29	29	29	28	27	28	29	29	29
9	36	.1763	14	12	28	26	25	24	23	22	23	24	25	26
10	24	.1894	9	6	29	26	25	24	22	20	22	24	25	26
10	32	.1894	9	6	25	22	21	20	19	18	19	20	21	22
12	24	.2158	I	A	20	17	17	16	14	12	14	16	17	17
12	28	.2158	I	A	18	16	15	14	12	11	12	14	15	16
14	20	.2421	F	F	16	12	10	9	6	4	6	9	10	12
1/4	20	.2500	17/64	17/64- 9/32	13	8	7	6	4	3	4	6	7	8
1/4	28	.2500	17/64	17/64- 9/32	6	3	3	3	2	I	2	3	3	3
16	20	.2684	9/32	9/32-19/64	6	7/32	7/32	2	I	A	I	2	7/32	7/32
18	20	.2947	5/16	5/16-21/64	I	C	D	1/4	F	G	F	1/4	D	C
5/16	18	.3125	21/64	21/64-11/32	C	1/4	F	G	H	J	H	G	F	1/4
5/16	24	.3125	21/64	21/64-11/32	F	17/64	.272	.275	9/32	.285	9/32	9/32	272	17/64
20	18	.3210	R	R-23/64	1/4	G	H	.270	J	.285	J	J	H	G
22	16	.3474	U	U-3/8	H	.274	.286	L	19/64	.306	19/64	L	L	.274
24	16	.3737	25/64	25/64-13/32	L	N	9/16	O	P	Q	P	O	9/16	N
3/8	16	.3750	25/64	25/64-13/32	L	9/16	9/16	O	P	Q	P	O	9/16	9/16
3/8	24	.3750	25/64	25/64-13/32	P	Q	Q	R	11/32	S	11/32	R	Q	Q
26	16	.4000	27/64	27/64- 7/16	O	Q	R	11/32	.351	T	T	11/32	R	Q
28	16	.4263	7/16	7/16-29/64	11/32	23/64	.363	U	3/8	W	3/8	U	U	23/64
7/16	14	.4375	29/64	29/64-15/32	11/32	23/64	U	3/8	.382	25/64	25/64	3/8	U	23/64
7/16	20	.4375	29/64	29/64-15/32	3/8	W	W	25/64	X	Y	X	25/64	W	W
30	14	.4526	15/32	15/32-31/64	23/64	V	.383	W	X	13/32	X	W	W	V
1/2	13	.5000	33/64	17/32	Y	27/64	.425	.430	7/16	29/64	7/16	7/16	.425	27/64
1/2	20	.5000	33/64	17/32	7/16	.448	29/64	29/64	.461	15/32	15/32	29/64	29/64	29/64
9/16	12	.5625	37/64	19/32	29/64	.476	31/64	31/64	1/2	.508	1/2	31/64	31/64	31/64
9/16	18	.5625	37/64	19/32	.490	1/2	.508	33/64	.519	.526	.519	33/64	33/64	1/2
5/8	11	.6250	41/64	21/32	1/2	17/32	17/32	35/64	.554	9/16	9/16	35/64	17/32	17/32
5/8	18	.6250	41/64	21/32	.553	9/16	.571	.575	37/64	.589	37/64	37/64	.571	9/16
11/16	16	.6875	45/64	23/32	39/64	.623	9/16	.631	41/64	.647	41/64	41/64	9/16	9/16
3/4	10	.7500	49/64	25/32	.620	.646	21/32	21/32	45/64	11/16	45/64	45/64	21/32	21/32
3/4	16	.7500	49/64	25/32	43/64	.685	11/16	.693	45/64	.709	45/64	45/64	11/16	11/16
7/8	9	.8750	57/64	29/32	47/64	.760	49/64	.774	.788	.803	.788	.774	49/64	49/64
7/8	14	.8750	57/64	29/32	25/32	51/64	.805	13/16	.819	53/64	53/64	13/16	13/16	51/64
I	8	I.0000	1 1/64	1 1/32	.838	.870	7/8	.886	29/32	.919	29/32	29/32	7/8	7/8
I	14	I.0000	1 1/64	1 1/32	29/32	59/64	.930	15/16	.944	61/64	61/64	15/16	15/16	59/64

Screens larger than #14-20 in machine screw sizes, are not recommended.

Tap drill sizes shown are for holes as deep as the diameter of tap. A 53% thread will break the bolt, before it will strip — in nine cases out of ten. For thin stock use 75 to 80 per cent thread tap drill.

For very thin stock use 100 per cent thread tap drill.

A 100 per cent thread is only 5 per cent stronger than A-75 per cent thread — But it requires three times the power to tap.

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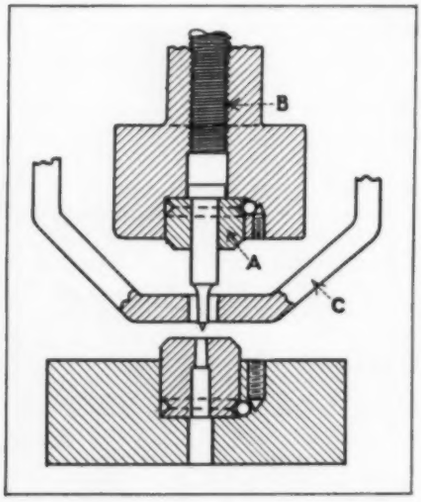
• IDEAS FROM PRACTICAL MEN

Inexpensive Piercing Tools

C. W. HINMAN
Chief Tool Designer,
Kobzy Tool Company

If but a few duplicates of perforated parts are wanted, the tools illustrated will be admirable for the purpose. They will readily handle stock up to ¼ in. in thickness and will locate holes within plus or minus 0.003 in. of the layout.

A cross-section of the tools is shown in the illustration. No leader pins are used because they would interfere in the working of large sheets. The tools should be designed for a press having a stroke of about 1½ in. and there should be no play in the ram slide. To take the thrust of the punch, which is a sliding fit in the guide holder *A*, the hardened screw *B* is fitted in the shank of the punch-holder. The ends of the stripper *C* are bent upward and rigidly attached to the head of the press by heavy screws passing through elongated holes. This feature permits adjustment to compensate for reduction in the height of the die by grinding.



Both the die and the guide holder for the punch are held in place by pointed screws and balls, as shown, and can be quickly removed for the substitution of other sizes and shapes of piercing members. A teat on the punch provides means for engagement in center-punch marks in the work, which are made through holes in a cheap templet, ⅛ in. thick, using a close-fitting center punch. For each hole in the work, regardless of its size, there is a corresponding ⅛-in. hole in the templet and near each hole is stamped the size of the required hole in the work.

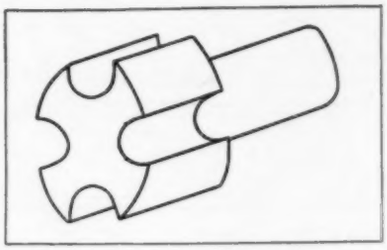
In use, the punch is pushed up in its guide holder by hand, using a fork for safety, and the work is pushed under the stripper. The punch is then allowed to drop, bringing its teat into the required center-punch mark. As the ram descends when the press is tripped, the punch recedes until its head contacts with the end of the screw *B*, when the continued downward movement of the ram forces it through the work. If the work is thinner than the length of the punch teat, so that the teat will not reach fully into the punch mark when the head of the punch is resting on top of the guide holder, than a spring pad is used around the die to hold the work higher, necessitating its being pushed down by the punch in piercing.

In tooling for a $40,000 job in which thousands of perforated parts were used, not more than ten or twenty of which duplicates, tools of this kind were used. Angle irons, crossbars, sheets, strips and many hundred pieces of fiber were pierced. Round, square, rectangular, oblong and other shapes were included in the holes pierced. The job was a competitive one in which the date of delivery was as equally important as the price. The best recommendation for our methods is that we got the contract.

Tools of Reamer Section
Discussion

FRANK C. HUDSON

The interesting article by Herbert M. Darling, "Tools from Reamer Section Steel" (*AM*—Vol. 76, page 498) recalls an experiment of perhaps 40 years ago when I was tool maker in a small shop. The only machine immediately available was a 13-in. Blaisdell lathe with a milling machine and planer in an adjoining shop that could be borrowed when not in use. Both were old, the milling machine having more chatters to the square inch than any other I've ever used or seen. Having several large solid taps to make I had the blacksmith forge up



the blanks with flutes as shown, after which the shank and body were turned and the thread cut. The intermittent cuts were rather hard on the threading tool, which was of carbon steel. After hardening, the cutting faces of the tap were ground back to remove any "dubbing" action due to the spring of the tool. The taps worked very well but finally gave way to taps with machine steel bodies and adjustable chasers.

A Light, Rotary Assembling Bench

P. F. CAVANAGH

It is singular that the possibilities of the rotary bench for assembling have not been more fully utilized, especially in these days of enforced economy. In light assemblies of a progressive nature, wherein the time may be standardized, the rotary bench has many advantages and its initial cost is far less than that of the conveyor type of bench.

A practical type of construction that meets average requirements and is inexpensive is illustrated in Fig. 1. A piece of 4-in. pipe is provided of sufficient length to reach from the floor to a ceiling support, which may be a piece of planking having a hole to receive the pipe. Two floor flanges are bored to the body size of the pipe, one being lagged to the floor, preferably over a beam and having a ½ in. plate under it to take the weight of the pipe and the bench. The other flange is pinned to

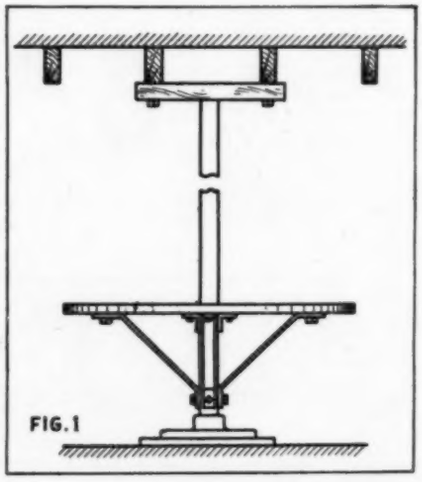


FIG. 1

the pipe at the proper height to act as a support for the round bench, while four or more pieces of flat iron are provided to act as braces.

The same principle may be utilized on a smaller scale for a bench for simple soldering operation. Such an application is indicated in Fig. 2. A light wagon wheel is mounted on the shaft of a small speed-reducing unit driven by a small motor. Holes in the felloe are provided for the parts to be soldered, or simple holding fixtures of various types may be mounted, as the work dictates. At the left is shown an assembly that may be quickly and uniformly soldered in such a device by two assemblers. One operator mounts the stem with its stamping and at the same time removes a finished part. The other operator places a piece of cut and fluxed solder at the point of union. After being adjusted to the proper speed and the blow pipe correctly positioned, the wheel will be remarkably constant in the matter of production.

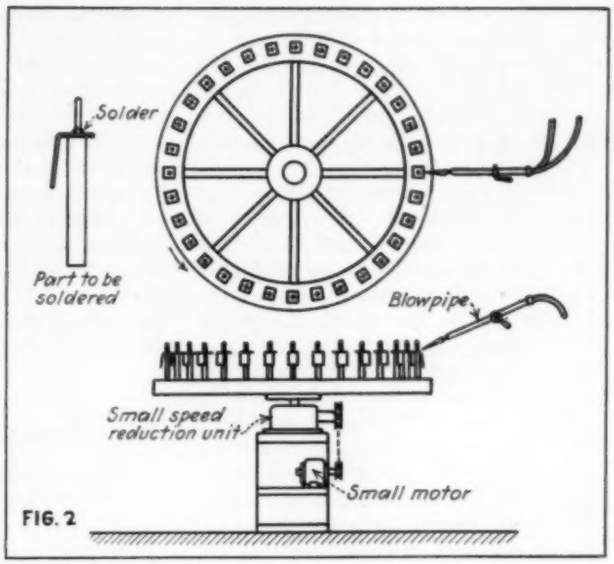


FIG. 2

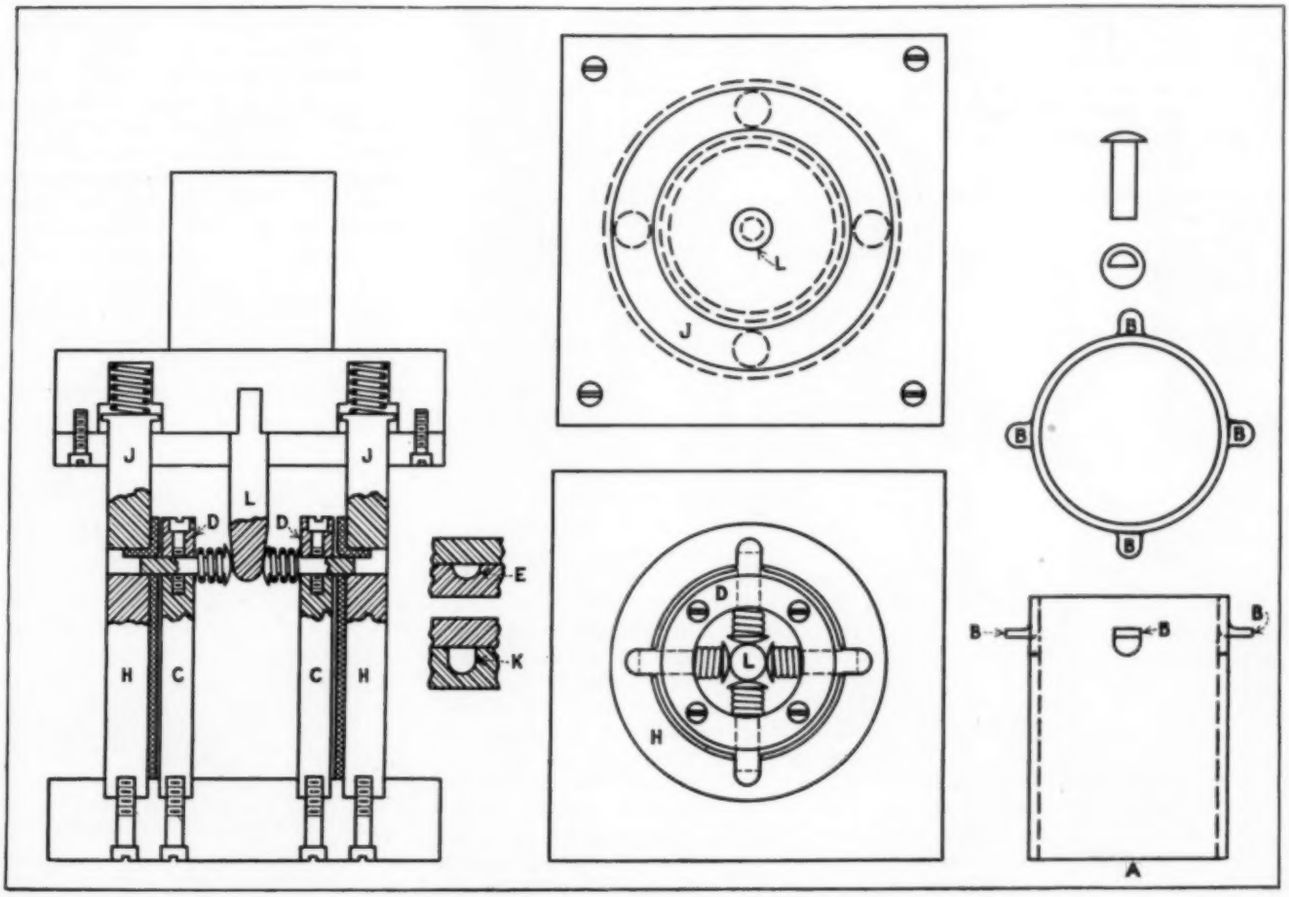
This device may also be used in spraying parts with a quick drying lacquer, in which case the spray nozzle takes the place of the blow pipe. In the case of round parts, such as cylindrical cases and covers, it is, of course, necessary to provide means for rotating the parts.

Tools for Forming Radial Ears

CHARLES KUGLER

The tools illustrated were designed for forming radial ears in brass tubing, as shown at *A*, the ears being indicated at *B*. The elevation is partly sectioned and the work is shown in place. In this view it will be seen that the ring for holding and guiding the radial punches is in two sections, *C*, and *D*, held together by screws. This method of dividing the ring eliminates all hand work, since the grooves for the four punches were milled in section *C*. When the two sections are fastened together, openings like the one at *E* are formed for the punches. The ring die is also made in two sections, *H* and *J*, the lower one being held in the die-shoe, while the upper one is held in the punch-holder. When these two sections are brought together, die openings like the one at *K* in the lower one of the small sectional views at the right are formed. While both of these openings have rounded bottoms of the same radius, there is a difference in height equal to the thickness of the metal in the tubing, because the metal is sheared at the bottoms and sides of the openings and the ears are bent against the tops.

In operation, as the ram descends, the



upper section of the ring die comes into contact with the lower section. Further downward movement of the ram compresses the springs in the punch-holder, permitting the wedge *L* to force the four radial punches outward and form the ears. As the ram ascends, the rising wedge permits the punches to be drawn inward by the springs on their inner ends. Since the section *J* of the ring die is attached to the punch-holder and goes up as the ram ascends, there is nothing in the way of removing the finished work. Two guide posts (not shown) are used to keep the tools in alignment.

A Simple Tool for the Set-Up Man—*Discussion*

PETER L. BUDWITZ

In an article under the title given above (*AM*—Vol. 76, page 504), J. Randall describes a tool for setting up work to a line. While the tool is both practical and simple, I believe that the present-day surface gage made by a reputable manufacturer offers a wider working range. While never having used a tool like the one described by Mr. Randall, I should think it would be easier to adjust the scriber of a surface gage to the work line by the sensitive screw than by the wiggler method, though I may be wrong.

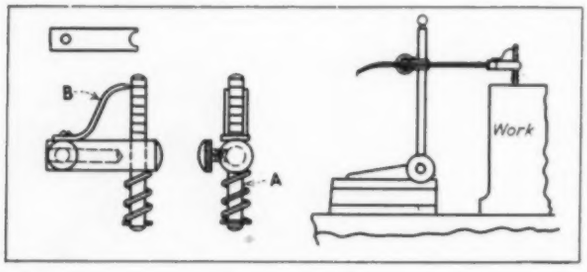
For some time I have used the device here illustrated for setting-up jobs. The device fits on the scriber of a surface gage, or on a special rod made to take the place of the scriber. It consists of the body by which it is attached to the scriber; the graduated contact pin *A*, sliding vertically in the body; the pointer *B;* and a light helical spring. The contact pin is graduated circumferentially in sixteenths of an inch, thus permitting the graduations to be seen at any position in which the surface gage may be placed. The pointer is stationary and the end next to the pin is hollowed to conform to the graduated part. The spring is placed between the shoulder at the lower end of the pin and the body of the device, having just enough tension to maintain contact of the pin with the surface of the work.

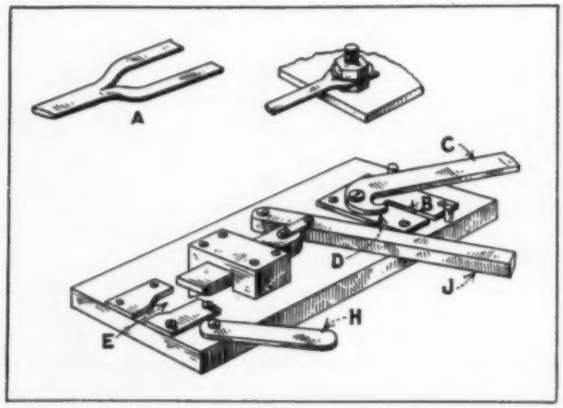
When using the device for setting up work, the surface gage is placed as shown in the illustration. By moving it from point to point, the graduations on the pin will readily indicate the correct amount of blocking needed at the several points to level the work. A typical application of the device is in setting up work in which one part of the surface must be set a definite amount higher than another. It may be used on work that is not required to be sufficiently accurate to need a test indicator, or where a wider range of variation is essential.

Fixture for Making Spade Terminals

D. J. REYNOLDS
Draftsman, Kelly-Koett X-Ray Manufacturing Company

A worthwhile saving has been effected by forming the ends of transformer leads, as shown at *A* in the illustration. The wire is flat, soft copper $\frac{1}{32} \times \frac{1}{8}$ in. and is to be connected to a ¼-in. stud, as shown. By forming the end of the wire into a spade, the cost of soldering a lug on it is saved and trouble from poorly-soldered lugs is eliminated. As the leads are of various lengths and the quantity to be made at one time is often as small as 100, it was decided to make one fixture for both slitting and forming.





In operation, the fixture is held in the vise and the wires, which have been already cut to length, are slit and formed by hand. The wire is placed against the gage in the slot *B* and the lever *C* is pulled against a stop pin, its edge slitting the wire the correct distance. When the lever is pushed back against the stop pin behind it, the hook *D* on its inner end straightens the part of the wire that was curled in shearing the slit. The slit end of the wire is then placed in the nest *E*, where it is clamped by the cam lever *H*. Pulling the lever *J* moves the spreading tool into the slit, opening out the ends and forming the spade.

The tool was made in 15 hr. and by its use a production rate of about 250 pieces per hr. was secured. When the lugs were soldered to the wire, the production was but 100 per hour.

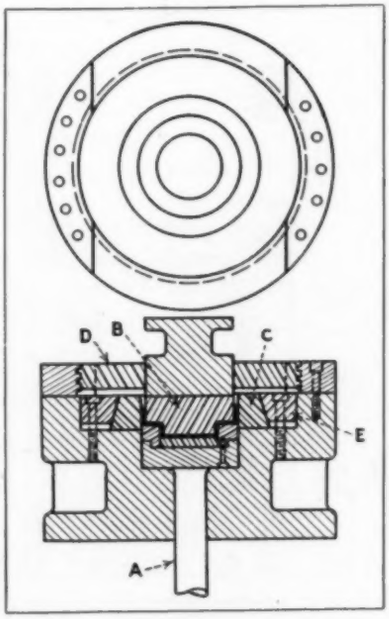
Press Tools for Brake Drums

ERNEST FOLDVARY
Consulting Engineer, Budapest, Hungary

Drawing brake drums from ⅛-in. steel to the shape indicated by the solid black lines in the illustration is a rather difficult job, especially when the bottoms must be flat.

The work is done in these tools in two stages at one stroke of the press. The The first stage is drawing the smaller diameter. This work is done against a pressure of 200 tons furnished by the plunger *A*, actuated by hydraulic pressure in a cylinder in a pit below the press. This pressure is required to prevent the plunger from sinking during the first draw and while the metal at the bottom of the drum is being flattened against the head of the plunger at the completion of the second draw.

After the first draw has been made, the ram continues its descent. The punch *B* pushes the plunger down against the pressure behind it, at which time the second draw takes place through the draw ring *C*. The retainer

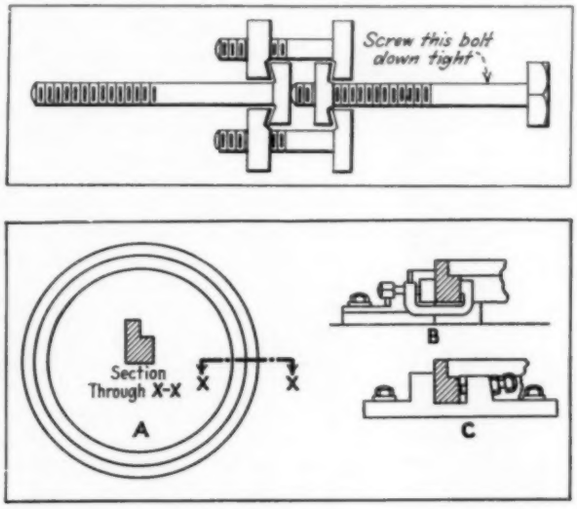


D is arranged for screw adjustment, so that the gap between it and the draw ring *C* can be varied, which is essential for the smoothness of the draw. This gap varies from two to three times the thickness of the stock and must be adjusted from time to time. The draw ring *C* is tapered on the outside and is held in place by the internally-tapered ring *E*. The reason for this construction is to avoid putting holes for the holding screws through the draw ring, in order to make it more solid and crack-proof.

An Improvised Extension Bolt

JOHN AURES

Needing a bolt to hold parts of a machine together and not having one long enough, I improvised the extension bolt illustrated and used it until a bolt of the proper length could be obtained The angular surfaces filed in the heads and the nuts kept these parts in place, both during the tightening process and afterward.



Holding Rings in a Boring Mill

IRA S. WILLIAMS
Western Electric Company, Baltimore Plant

We had considerable difficulty in holding some rings, such as the one shown at *A*, in the chuck jaws of our vertical boring mill. To avoid distortion, the rings had to be held so lightly that they would not stand the pressure of the cut without shifting. We then tried holding them by the method indicated at *B*. Four small blocks were clamped to the rings by C-clamps, the blocks bearing against the sides of the chuck jaws. Parallels were placed under the rings so that the C-clamps would clear the table. However, this method proved to be too slow.

Then we made four fixtures, as shown at *C*, to replace the chuck jaws. These fixtures were clamped to the rings by screws set at an angle, so that the rings would bottom in the fixtures. Then with the work centered, the fixtures were made fast to the table. A circle scribed on the table and of a diameter equal to that of the inside of the rings, greatly aided in centering them by acting as a guide. This method proved to be entirely satisfactory.

A Small-Shop Kink

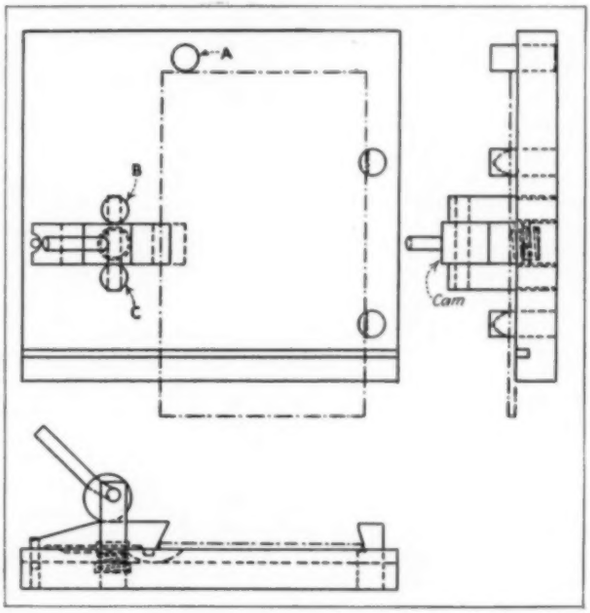
C. G. WILLIAMS
Consulting Mechanical Engineer

Upon reading the article by Charles H. Willey under the title given above (*AM*—Vol. 75, page 898), I was reminded as to how we did a similar job. We had several hundred steel plates that had been cut too small for one contract yet they were too large for another. The purpose was to reduce the size at the lowest possible cost.

In a cast-iron plate, five holes were drilled as per the accompanying sketch. Three of the holes were reamed for press-fit dowels, while the other two were tapped to receive studs to act as bearings for a cam pin. A small clamp and a cam lock were made so that by raising the cam lever a spring would raise the clamp and release the plate, permitting it to be slipped out of the fixture and another plate to be slipped in. The holding end of the clamp and the projecting ends of the dowels were undercut so as to draw the work down.

Using the fixture on the milling machine, it was found that by cutting the plates with ⅛-in. slitting saw, the pieces cut off could be used, as cut, for still another contract, thus really making a saving by the operation. After the job was finished, the fixture was relocated on the machine table to cut the pieces needed for the original contract. Generally speaking, the table feed was above 3 in. per minute.

Later on, as other orders came in requiring its use, the fixture was elaborated upon. The pin *A* was removed and an adjustable stop was made to take its place. Studs *B* and *C* were removed and an adjustable block containing both the cam and the clamp was substituted. Both the stop and the block were provided with tongues to fit in grooves in the fixture plate. The fixture became a permanent one and was often used for trimming the edges of ⅛-in. armor plate that had been cut to approximate size by a gas torch.

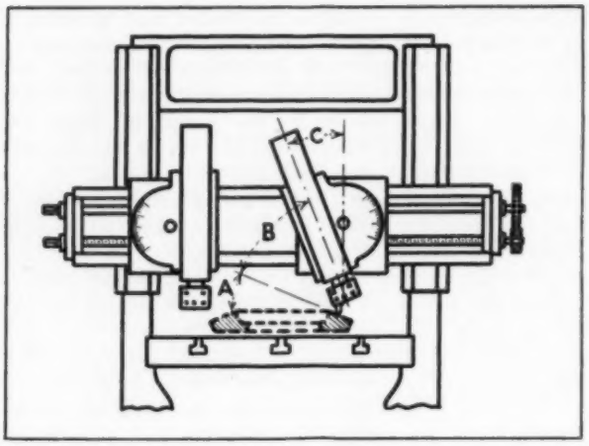


Angular Facing on a Vertical Boring Mill

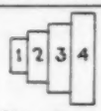
F. L. GILLETT
The National Supply Company of California

A small quantity of bevel gear blanks were to be bored, turned and faced on a vertical boring mill. The blanks were approximately 3 ft. in diameter and the faces were 5 in. in width, the angles varying from about 7 to 14 deg. from the backs. Since the boring mill ram could not be set at an angle less than 30 deg. from the horizontal, we successfully adopted the following method:

We made a pair of pick-off gears having a ratio of 3 to 1, placing the smaller gear on the cross-feed screw and the



Size of Drill in Inches That Can Be Safely Run with Belt on Indicated Steps of Top Cone



Top Cone

Materials	Spindle Speed r.p.m. without Back Gears				Spindle Speed r.p.m. with Back Gears			
	1 372	2 216	3 138	4 83	1 67	2 40	3 25	4 15
Brass	1½	2						
Hard C.I.	⅜	⅝	1	2				
Machine Steel	½	1	1½	2				
Tool Steel	¼	½	⅜	1¼	1¾	2		

larger one on the spline rod for the down feed. By driving the down feed through the cross-feed screw, the tool traveled at an angle to the face of the table, and by tilting the ram at various angles a range of facing angles from approximately 6 to 14½ deg. could be had. While this range took care of all our work, a further range can be obtained varying the ratio of the pick-off gears. The angle to set the ram was computed by the following formula:

Let A = the angle of the surface to be faced.

B = the angle from the surface to faced to the center line of the ram.

C = angle of center line of ram from the vertical.

R = ratio of pick-off gears.

Then $\sin B = R \sin A$, and $C = 90 \text{ deg.} - (A + B)$.

To complete the job, we made removable sheet-metal guards to cover the gears.

On some of the larger boring mills, the cross-feed screw and the spline rod have squared ends on which are placed handwheels for feeding by hand. For a machine of this type we made a pair of pick-off gears, the smaller one being permanently attached to the cross-feed screw, while the larger was a ring gear attached to the rim of the handwheel on the spline rod.

Information for Drill Press Operators

HERBERT P. HINCKLEY

President, Herbert Hinckley, Inc.

Since many of the workmen who operate our drill presses have but a faint idea of what constitutes a safe maximum speed for drilling different metals, we made charts such as the one illustrated and attached them to our drill presses just above the motor switches. The charts were made from data obtained from handbooks. In the three years that the charts have been in use, we have had no trouble from drills being burned.

A Spring Boring Bar

DANIEL DOOLITTLE WELLS

An ingenious example of an adaptation of the resilient-tool principle to boring bars is shown in the sketch. Bars of this type were developed originally for threading "joints" in the oil field. The joints in a "string of tools" have inside and outside threads of steep taper and the threads must be smooth. For cutting the internal threads, the bar illustrated was developed.

The bar is cut half-way through from the point X-Y for several inches back. This gives a spring or resilient effect, as the bar will twist or wring around slightly at the thin part under the strain of the cut. In addition, the end of the bar is slotted from the bottom to a point above the cutting edge of the tool and running well back of the tool, thus giving the tool a true overhang support.

A tool held in a boring bar of this type has all the advantages of a gooseneck tool. But gooseneck tools are not generally adaptable to boring bars used in a lathe, because the hole to be bored is often but a little larger in diameter than that of the bar itself. A bar of the type illustrated is a good general-purpose tool where light cuts only are taken, as in boring metalic packing for piston rods. It is probable that other special tools could be developed, using the same principle.

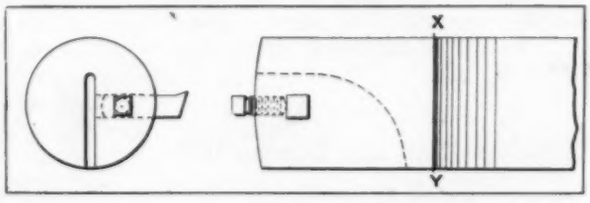
Buttons for Backing Work to be Faced

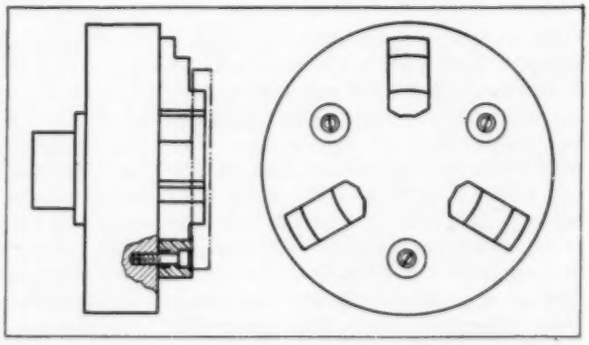
EDWARD HELLER

Where a great deal of chucking work is done and the work is of a nature that requires a second operation of facing, buttons attached to the face of the chuck, as indicated in the illustration, are useful.

The buttons are circular, of a height to suit the requirements, and as many in number as there are jaws in the chuck. They are held to the face of the chuck by screws in any of a series of holes drilled and tapped therein. In the larger sizes of chucks provided with T-slots, the buttons may be attached by means of T-headed bolts.

The work can be held by the jaws either from the inside or on the outside, as conditions permit, and when forced back tightly against the buttons it can be faced with the assurance of being parallel. A few sets of the buttons of various heights, together with some shims of different thicknesses, can be made to take care of a variety of work.

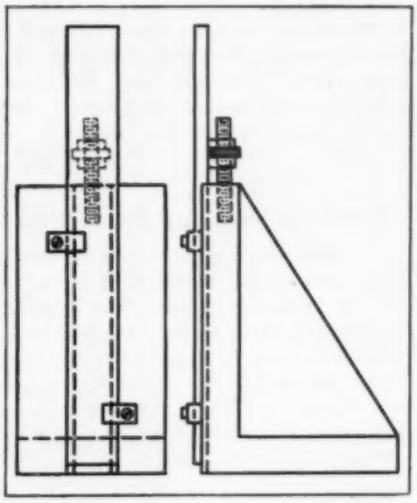


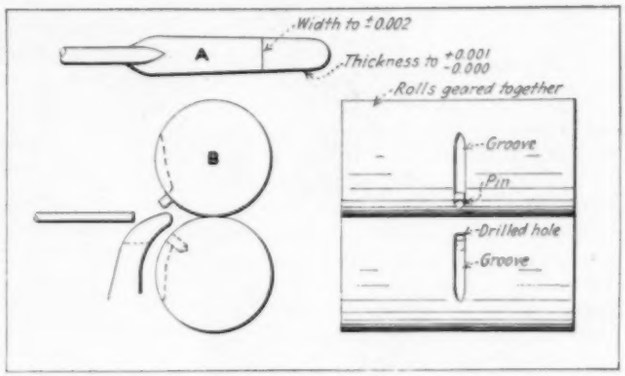


Flat-Spring Rolling Die

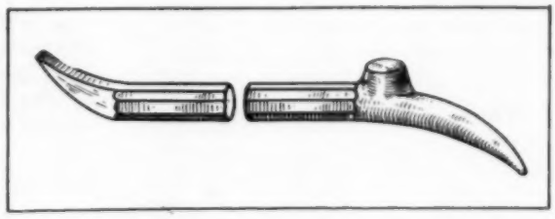
E. J. TANGERMAN

In the manufacture of a pyrometer at Brown Instrument Company, it was necessary to form from wire a flat spring of the type shown at *A*. Both aluminum and phosphor bronze wire were to be used, and the width and thickness of the spring, as well as the length of the unflattened wire, had to be held to close tolerances. Finally the device illustrated at *B* was hit upon. It is simply a pair of rolls geared together and operated by hand crank. One roll carries a pin which fits into a hole in the other. These form the stop for the wire fed in. Extending from both the pin and hole is a short groove of the length and contour required for the only partially flattened portion of the spring. When these grooves run out, the rolls provide only enough clearance to produce the flattened wire tolerance of plus 0.001 in. maximum.





In operation, a fork-shaped guide is positioned before the rolls. The rolls themselves are arranged so that the pin enters the hole at some certain point of the crank revolution. Then short lengths of wire are simply fed through the guide with the rolls positioned so that the pin acts as a stop. Production with this simple device runs around 25 pieces per min. Two sets of grooves may be used, one positioned with the crank at the top stroke, the other at the bottom.



A Handy Cotter-Pin Puller

F. M. A'HEARN

A machinist drawing a heavy cotter pin was using a puller similar to the one illustrated. The tool was forged from a bar ⅞-in. octagon chisel steel and one end was formed into a shape similar to that of a nipping bar, while the opposite end was drawn to a point in order to enter the eyes of small sizes of cotter pins. As shown, a striking block was welded in a suitable position near the pointed end. The overall length of the tool is approximately 18 inches.

In drawing a ½-in. cotter pin that was tight in the work, it was surprising to see how well the puller remained in position as the machinist drove upon the striking block with a heavy hammer. The dangerous glancing blows noticed when driving on the side of a curved, round bar were avoided.

A Layout Fixture

IRA S. WILLIAMS
Western Electric Company, Baltimore Plant

In laying out work with the surface gage, it is customary to set the scriber to a scale that is held vertically either in the stock of a combination square, or by clamping it against one side of a block. I have found this method to be slow and the chances of setting the scriber to the wrong graduation to be many.

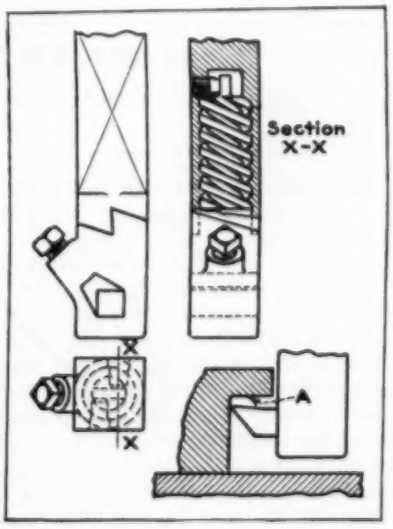
A better method is to use an angle plate having a vertical slide clamped in a groove and adjustable by a knurled nut on a stationary stud, as shown in the illustration. In use, the slide is coated with either chalk or whiting and the necessary dimensions are transferred to it. The workman sets his surface gage to the lines on the slide, there being no other lines to confuse him. If two lines on the slide are close together, an identifying mark can be placed on each of them.

In a great many layout jobs the work is set upon jacks, or wedges, and all dimensions are taken from its center. In such cases the center line is transferred to the slide and all other necessary lines in correct relation to the center line are also scribed upon it. As each piece of work is set up on the layout plate, the scriber is set to the center line already established and scribed on the work. Then the slide is adjusted to bring the center line on it and the one on the work into coincidence. All other lines can then be transferred from the slide to the work. The device is, of course, intended only for layout jobs is which there is more than one piece of a kind.

A Toolholder for Undercutting

D. Q. DUNSTONE
Hetton-le-Hole, County Durham, England

Where the under surface of work, such as is indicated at *A* in the illustration, is to be machined in a planer or a shaper, it is essential that the clapper be securely clamped down. In such cases some difficulty will be experienced unless adequate provision is made for tool



clearance for right-hand work and the other end for left-hand work. The main body is of square section, blending into round at the ends, and is threaded for triple-thread screws of ½ in. lead. Since the only difference in the ends is that of direction of operation, one end only will be considered in the description. Beyond the internal thread, a bore of a diameter equal to that of the root of the thread is continued for a convenient depth. One member of a two-jaw clutch is machined on the end, the helix of which is of the same lead and direction as that of the thread.

The shank of the toolholder proper is threaded to mate with the internal thread in the body and has a mating member of the two-jaw clutch to engage with the one on the end of the body. Two hollow screws, each accommodating a spring and a plunger are fitted crosswise of the body at the end of the internal thread, the plungers bearing eccentrically on each side of the toolholder shank. The positions of these screws in relation to the center line of the body are indicated in the end view.

In operation, when the tool is cutting, the faces of the clutch jaws are in contact, forming a positive stop against rotation of the toolholder in the direction of the thrust of the cut. On the return stroke, the drag of the tool rotates the toolholder against pressure of the spring-actuated plungers, partially unscrewing it from the body and lowering it to give clearance to the toolbit. As soon as the toolbit entirely clears the work at the latter end of the return stroke, the spring-actuated plungers rotate the toolholder and screw it back in the body. This action causes the clutch jaws to contact and arrests further rotation. At the same time, the toolholder has been raised and the toolbit has been brought into cutting position.

SEEN AND HEARD

JOHN R. GODFREY

That Isn't New—

"I wonder if the editor thinks that's a new idea! Why I saw something like that years ago." That's what I hear occasionally in various shops, where the various Solomons get a kick out of criticizing the papers. They seem to forget that there is always a new crop of younger readers coming along to whom many "old ideas" will be new. We've been teaching that "two and two make four" for a long time. It isn't new but there are some who don't yet know it and we have to tell them. And if the editor thinks an idea is new you can bet it will be new to many readers even if a few old timers have seen something like it way back in the dark ages. Being new isn't as important as being good, and being unknown to the majority of readers.

Choice in Steel for Piston Pins

We have made great strides in metallurgy and in the selection of steels we use for various purposes. But it is still far from an exact science, which is probably fortunate in some ways at least. Take the piston pins in aircraft engines as an example. Three types of steel are used, oil-hardening, carburizing and nitriding, and all three seem to be about equally successful. It seems to be another case where the one best bet doesn't work out in practice.

Mechanical or Oil Feeds?

A few designers are going back to cam feeds for drills and similar cutting tools, as being more simple than oil or other hydraulic devices. But, as in most other cases, there are places where the positive feed isn't so good. In drilling, for example, a hard spot in the metal may wreck a drill if a positive feed is maintained. With the oil pressure feeds there is more of a cushion and it is said to be much easier on tools. Perhaps the cam feed could be driven through a friction that would slip when the tool encountered undue resistance. Tool life is a factor that must not be overlooked.

Where T-C Ousted the Diamond

Diamond turning tools never made a very big dent in the machine shop although they were, and are, used in some of the best plants. Not only the first cost of the diamonds but the inability of most plants to dress them when necessary involved more delay and expense than many cared to tackle. Yet in some shops the diamond did great service in boring bearings and even in precision shaping in one case at least. One shop has found, however, that a cutter of T-C gives about four times the life of a diamond on its particular work, and at a cost of from one-sixth to one-eighth for the tool itself.

It Pays to Anneal

It's a bit striking to turn a hard, chilled casting with T-C alloy tools and to tell the high-speed salesman how you did it. But it's a lot cheaper to anneal the castings before you turn them, even though you could do it without. Some recent tests showed that the life of a T-C tool was increased about 600 times by careful annealing to a fairly high temperature.

Personal Supervision Saves Paper Work

Filling out forms seems to be the chief aim in life in some shops. In others, they duck as much paper work as possible. I knew a large auto shop where they checked out small drills in lots of a dozen or two so the man always had a supply and didn't delay his work to hunt a tool crib. The drills cost less than the paper work to keep track of each one, and the time saved at the machine was clear gain. In the same way, some shops are cutting out paper work in looking after the salvaging of parts and tools. By making it the duty of a conscientious man to supervise salvage, the losses are kept at a minimum. The inspectors pass or reject work according to their gages. But the right man has discretionary power that cannot be put into words, and keeps things moving at low cost.

Standard Shanks for Rotating Tools

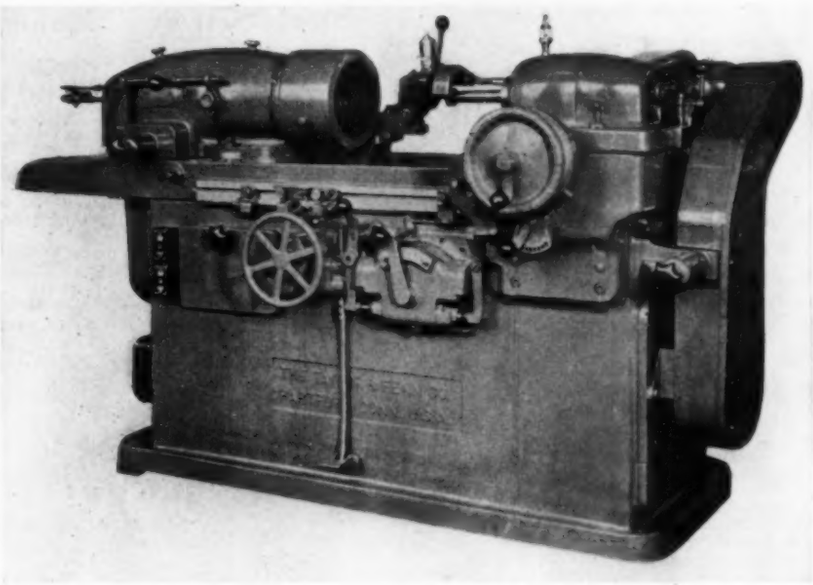
A committee is at work on the standardization of shanks for rotating tools with a view of reducing the number of sizes necessary. Tap shanks are already well standardized both as to diameters and squares. Reamer shanks differ from tap shanks and do not seem to be standardized to the same degree. The development of better devices to hold and drive straight-shank tools and to eliminate the necessity for taper shanks is an added incentive toward both standardizing and simplifying the shanks of all rotating tools.

Burying Castings to Season Them

Aging of castings seems to have gone into the discard. When business is brisk no one wants to pile up castings for three or four months after taking a roughing cut, as used to be done in the automobile and other industries. When business is dull, there is plenty of time, but no one wants to tie up money in castings. Annealing to about 900 deg. F. after the first machine cut was also considered equivalent to aging. But I ran across a case recently that tops them all.

After keeping a lot of small castings for several years in the hope of utilizing them, they were used as ballast under a spur track, being of course mixed with earth, ashes and the like. About a year afterward the firm got an order for a lot of the devices, dug up the castings and filled the order. The men all swear they machined better than any castings they ever cut, and the parts didn't change shape as much after machining as usual. Should we go back to seasoning castings in the yard, as we once did?

SHOP EQUIPMENT NEWS



Taylor & Fenn Hydraulic Internal Grinder

The hydraulically-operated internal grinder illustrated, recently developed by the Taylor & Fenn Co., Hartford, Conn., is offered for use in shops where short-run work of a variety of types and sizes, rather than continuous long-run work, is the rule. Straight and taper holes up to 8 in. in diameter and 8 in. long can be ground. The work reciprocates instead of the wheel-head, an arrangement permitting use of a heavier table with wider spread of ways, and a rigid work-head; it also simplifies application of the motor drive. When grinding, the wheel contacts with the back of the hole. Two ball-bearing motors inclosed within the base drive the machine; one of these, rated at 5-hp., 1,200-r.p.m., drives the hydraulic pump and the grinding-wheel spindle, and the other, rated at 1-hp., 900-r.p.m., drives the work-head spindle.

The table that carries the work-head is reciprocated hydraulically, the grinding wheel feed-screw also being actuated hydraulically. Table speeds ranging from 0 to 44 ft. per min. are obtained through the throttle valve, which admits oil under pressure to a piston-type reverse valve controlled by adjustable table dogs. When desired, as in setting up new work, the table may be moved by hand. Power feed is automatic through the hydraulic reverse valve, but provision is made for hand feed, either rapid or slow, when desired.

Automatic table traverse is controlled by four adjustable dogs, two of which are used for grinding, one for the wheel truing position and one as an automatic cutoff and safety stop. Means are provided for reversing the table by hand at any point of its travel.

The work-head can be swiveled 15 deg. for taper grinding. Its spindle runs in large oversize ball bearings which are lubricated constantly by a pump. The pulley on the spindle provides two standard speeds, 275 and 760 r.p.m. It is supported independently by a bracket attached to the inside of the work-head, an arrangement intended to eliminate belt pull on the spindle. When idle, the pulley revolves on a double-row ball bearing. The 1-hp. work-head spindle motor is suspended on a bracket attached to the underside of the work-head. Starting and stopping of the work is controlled by a single lever that engages and disengages the clutch assembled in the spindle pulley. A 1⅛-in. hole through the spindle accommodates a chuck-operating tube.

Quill, naked and sleeve-type ball-bearing wheel-heads can be furnished. The grinding wheel is provided with a safety guard that falls in place automatically when the work-head is withdrawn for loading and unloading the chuck.

The maximum swing over the table is 16 in. and the maximum table travel is 20 in. Distance from the center of the work spindle to the floor is 45 in. The machine requires floor space of 40 x 98 in. and the net weight, complete with motors, is 5,375 lb. It will be marketed by the Pratt & Whitney Co., Hartford, Conn.

Glyptal No. 1281 Gasket Compound

A gasket compound, which is oil-proof even in hot oil, and which is also proof against gasoline, kerosene, benzine and similar solvents, has been developed by the General Electric Co., Schenectady, N. Y. Known as Glyptal No. 1281, this compound may be used in contact with cemented joints and is a grey or brown, odorless, sulphur-free alkyd resin material. Gaskets of the material are used in the assembly of solid-type compound-filled bushings for oil-filled apparatus, and between the bushing and the apparatus. The material can be obtained in sheets up to 13 by 36 in., and in thicknesses from 1 mil to ⅛ in. thick.

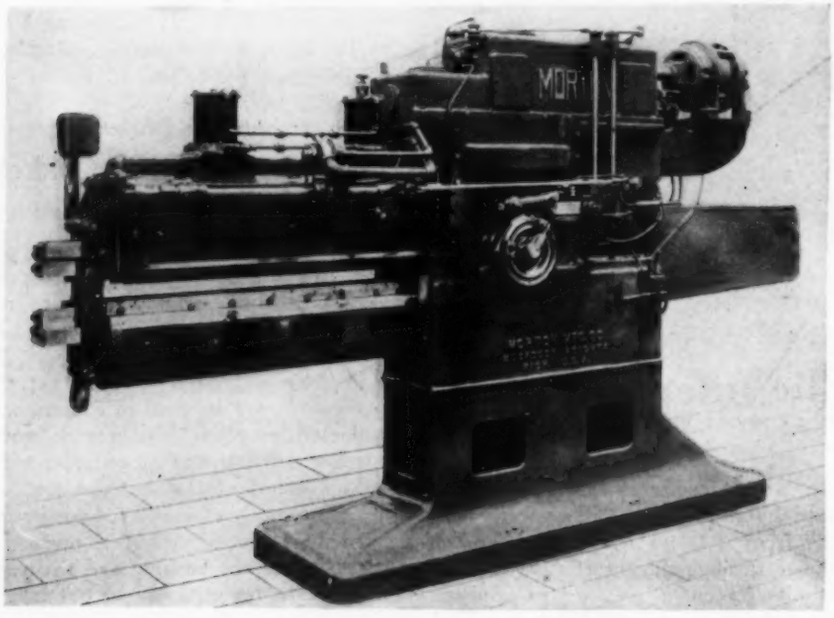
"Ingoclad" Two-Ply Stainless Steel

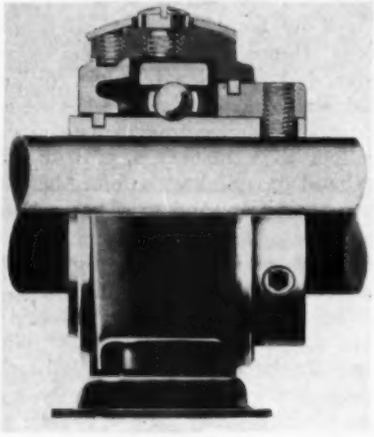
The Ingersoll Steel & Disc Co., Chicago, Ill., a subsidiary of the Borg-Warner Corp., has perfected a two-ply stainless steel known as "Ingoclad." The product is being made at the Newcastle, Ind., plant. It may be deep drawn, stamped, welded, formed and polished, and is now being produced in various gages and sizes. The metal is produced by a patented process from the composite ingot.

Morton Draw-Cut Flash Trimming Machines

For removal of flash or upset on steel barrels or butt-welded sheets or plates, the Morton Mfg. Co., Broadway & Hoyt St., Muskegon Heights, Mich., has developed a line of draw-cut flash trimming machines. One such unit is designed primarily for removal of flash or upset on steel barrels after being butt welded is illustrated. Two rams are provided for removing the flash from both sides at the same time. The upper ram is carried in a guide-way which is movable vertically and which also forms the base for securing the upper clamping jaw. The vertical movement is accomplished by air cylinders, which acting through compounding leverages, deliver sufficient pressure to straighten and clamp the work. Rams are reciprocated by means of reversing clutches so controlled that the machine makes one cycle and stops. All of the trimming that is removed from the inside of the drum drops through free openings in the lower ram. The rams carry a multiple number of cutting tools which are readily adjustable for height. Straightening rollers precede the cutting tools to help take out warpage caused by welding and handling. It is said that the machine will trim both inside and outside and hold the seam within 0.010 in. greater than the metal thickness.

The machine illustrated has a working stroke of 40 in., and distance between the center of the ram and the floor is 42 in. Approximately 5 hp. is required. In the 72-in. stroke machine for trimming flash from butt-welded sheets the upper arm raises a distance of 2 in. before the reversal takes place to make possible easy removal of the work. This machine also has a special air chuck, which through eccentrics and rollers, raises the sheet automatically from the die when aligning the work for trimming or removing the sheet from the machine after the trimming operation.



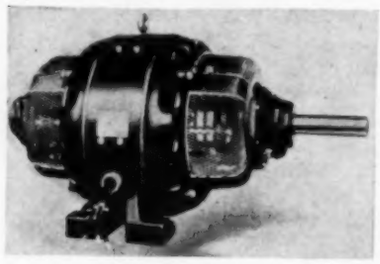


Dodge Type DH-1 Ball-Bearing Pillow Block

Two-piece pressed steel construction for the housing and automotive piston ring type grease seals are the two outstanding features of the Type DH-1 ball-bearing, self-aligning pillow blocks announced by the Dodge Mfg. Corp., Mishawaka, Ind. These pillow blocks use Hoover single-row ball bearings. The use of steel instead of cast-iron for the housing permits smaller over-all dimensions, and the split feature facilitates installation or removal of the bearing. Both radial and thrust load capacity is provided. The pillow block is of the expansion type and can be furnished also in non-expansion type. Sizes of blocks are available for shafts from ¾ to 2 7/16 in.

Ideal "Self-Syn" Motor

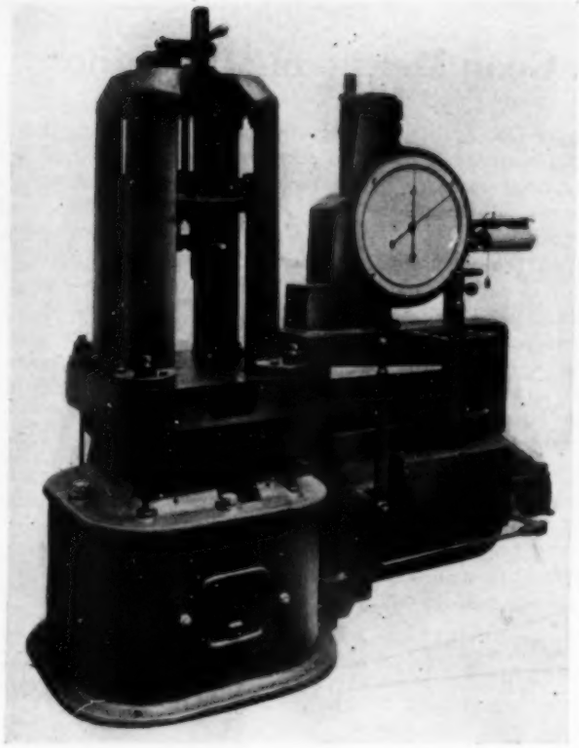
A synchronous motor for industrial and general-purpose applications has been developed by the Ideal Electric & Mfg. Co., Mansfield, Ohio. This "Self-Syn" motor is compact, self-excited, self-synchronizing, and self-contained and requires no external excitation. It is started with a hand-operated compensator in the same manner as an ordinary induction motor. It will re-synchronize itself automatically after having been pulled out of step by a line-voltage dip or a momentary overload. Unity or 80 per cent leading power factor is standard. These motors are supplied in all sizes from 5 to 100 hp. at 900, 1,200, and 1,800 r.p.m.



Olsen Four-Screw Universal Testing Machine

The Tinius Olsen Testing Machine Co., 500 N. 12th St., Philadelphia, Pa., has introduced an improved model of its four-screw rotating gear nut type of universal testing machine. The 100,000-lb. capacity unit illustrated has a gear drive with eight-speed automotive gearbox producing cross head speeds of zero to 8 in. per minute. Gears are always in mesh and may be shifted without operating the neutral control lever.

The self-indicating dial, a new feature, is not hydraulic, but is mechanically operated under control of a lever and pendulum primary weighing system. The pointer may make two complete revolutions to capacity, providing the equivalent of two dials in one and enab-



ling the operator to read small increments of load. The pendulum may be calibrated to within $\frac{1}{10}$ of 1 per cent accuracy, and it may also be provided with an additional hand that can be made to rotate at any predetermined speed in order to secure a specific rate of loading of the test specimen in pounds per minute, besides the general practice of specific crosshead speed in inches per minute. Each machine may be obtained in single, dual, triple, or quadruple capacities, and the autographic sheet may be read directly in any one of these. The machine is also furnished with a hydraulic loading and lever weighing system, so arranged with automatic control as to provide constant crosshead speed regardless of load and to give quiet and fast testing for production work.

Whiting Triple Valve Bushing Truer

Maintenance of air brakes is the function of the triple-valve bushing truer placed on the market by the Whiting Corp., Harvey, Ill. This air-operated portable tool is designed to give the bushing a perfect bore with a minimum amount of stock removal. Although the A.R.A. test rack requirements for leakage of packing rings fitted to trued bushings are not more than 5 lb. per min., packing rings fitted to bushings trued with this machine have a leakage of less than 2 lb. per min. The floor-to-floor time is 1½ min.

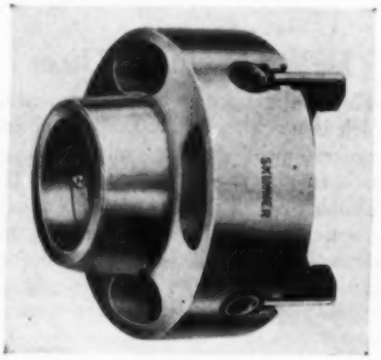
A roller-bearing mounted motor is built in, and the upper end of its shaft terminates in a knurled nut so that the motor may be turned by hand when necessary. A control spindle controls the rotative motion, down-feed, and up-release of the cutting spindle. At the upper end of the main or cutting spindle there is a large knurled collar used to turn the spindle by hand. This collar is graduated to one-quarter thousandths. Above this is a small knurled nut to which is attached an indicator that controls the in and out movement of the three adjustable jaws, one each of which is located at one of the three points of the centering head attached to the end of the main spindle. Only one adjustable jaw holds the cutting tool which is tipped with tungsten-carbide and may be set for a predetermined cut. A holding fixture goes with this machine and it is equipped with two hand-operated hooked clamps.

Brown & Sharpe Thickness Gages

Two thickness gages, Nos. 645 and 647, have been announced by the Brown & Sharpe Mfg. Co., Providence, R. I. These gages have tapered blades 3 in. long and ¼ in. wide at the tip. No. 645 has nine blades varying in thickness from 0.0015 to 0.015 in. No. 647 has 26 blades varying in thickness from 0.0015 to 0.0025 in. inclusive. Both gages have blade locks, a device that makes it possible to clamp any desired blade or blades in position for use. Blades can be used either singly or in combination.

Integral Mount Jaw Chucks for Hardinge Bench Lathes

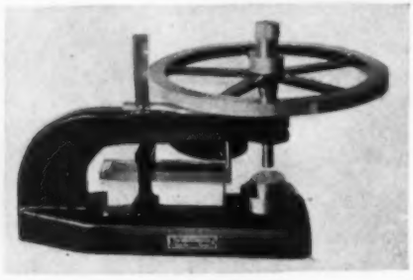
Integral mount universal chucks and independent chucks are now available from the Hardinge Bros., Inc., Elmira, N. Y., for use on its bench lathe. These chucks, developed for the company by the Skinner Chuck Co., do away with the usual "screw-and-plate" mounting, the mount becoming a part of the chuck itself to eliminate mounting errors and



trouble. Accuracy is increased by the minimized overhang. After assembly, the chucks are mounted on "Cataract" cone nose live spindles and the jaws are ground for accuracy on all gripping surfaces, thus producing a chuck especially adapted for precision work.

Van Keuren Light-Wave Micrometer

An accurate bench micrometer using light waves as an indicator of contact and measuring pressure is a recent development by The Van Keuren Co., 12 Copeland St., Watertown, Mass. The instrument as shown has a 6-in. measuring wheel graduated in units of 0.0001 in., permitting estimated readings of 0.00001 in. A movable index is provided for quick setting at the zero position. An optical flat is held in contact with a 3-in. steel flat with spring pressure and is connected by a tension rod to



the arm supporting the micrometer head. Thus, bending of the micrometer arm is detected by a movement of the light-wave interference bands. While the instrument is operated and read as a micrometer, slight variations in size due to taper, out of roundness, or from other causes, can be determined from the movement of the light-wave bands.

Since the micrometer is provided with two flat parallel measuring faces and can be used with a light or heavy measuring pressure, it is suitable for a wide variety of uses, including the measuring of gages and for general shop use.

DeVilbiss Fluid Hose

Fluid hose lined with a composition, which is not affected by turpentine and lacquer finish, gasoline, oil or grease, has been placed on the market by The DeVilbiss Co., Toledo, Ohio. The hose is particularly suited for use in finishing rooms. It is said that the material used for the liner does not loose its original flexibility and that the hose will withstand rough usage.

Fellows Gear Measuring Machine

The Fellows Gear Shaper Co., Springfield, Vt., has recently placed on the market a gear measuring machine which is simple in design and is easy to operate, so that it does not require a high degree of skill on the part of the operator, and yet it is capable of checking gears to close limits. It comprises a pedestal upon which is mounted a rotatable table. The work is held on a vertical work-arbor, and the fixture carrying the measuring instruments is located on top of the table.

The various elements of a gear tooth that can be checked on this machine are: involute profile or shape, circular pitch, pitch diameter, and eccentricity; also the lead or corresponding helix angle of helical gears, guides, and helically-splined members.

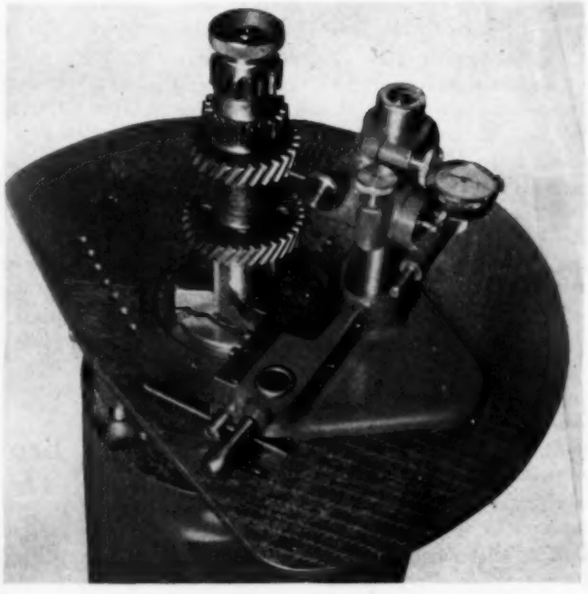
The column can be adjusted to any desired height through gearing, and is positioned through the medium of thickness gage blocks. The work-holding adaptor can be aligned in the vertical position and also at right angles to the table top by four screws that project from the pedestal. The fixture which carries the dial indicator and the various inspection units is so made that it can be moved about on the table when measuring involutes; fulcrumed to the table when inspecting circular pitch, lead, pitch diameter, and eccentricity.

For inspecting involutes, as shown, a master involute gage is employed, against which the involute of the gear tooth is compared. Contacting with this master involute gage, when the inspection test is being made, are angular guide bars forming the sides of two rack teeth, which control the position of the fixture as it is being moved about on the table; thus enabling the operator to compare the gear tooth with the master gage.

For checking the lead of helical gears, two methods can be employed: One by the use of offset or stepped master involutes, and the other by the socalled sine bar method. The stepped master involutes enable the involute of the tooth to be checked at two points at the same time that the lead is being inspected, thus eliminating computations.

For checking circular pitch, a special unit carrying a fixed stop and spring is attached to the fixture. A ball pointer replaces the involute pointer, and the gear is indexed from one tooth to the next, and the variations in position of the indicator needle noted.

For checking pitch diameter and eccentricity, master gage disks are employed for setting the cone pointer to the correct radial position. A separate cone pointer is required for every pitch and pressure angle.

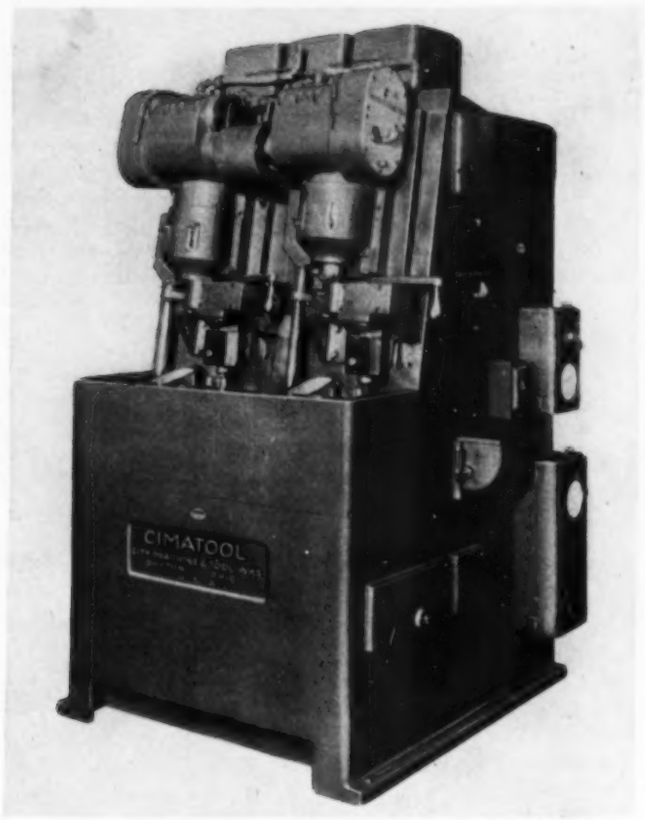


Close-up view showing arrangement for checking involute tooth shape, comparing it with a master involute gage.

One of the features of this machine is its capacity for duplicating measurements to within close limits. The position of the work-holding adaptor is set with a thickness feeler so that the weight of the column at no time rests on the gage block projection. This feeler gage is also used when thickness gages are employed in setting for height so that the desired sensitiveness is continuously maintained. This machine has a capacity for measuring gears from 2 to 7 inches pitch diameter.

Porter-Cable Type DB Power-Feed Sander and Grinder

Sanding and grinding both sides of parallel work in one operation is the function of the power-feed, double-belt sander and grinder, Type DB, developed by the Porter-Cable-Hutchinson Corp., Syracuse, N. Y. The operation consists of feeding the work through by means of power-feed rollers, which give a uniform feed, the sanding being done between two large drive pulleys which are rubber-covered to give a cushion to the abrasive belts. The belts run in opposite directions, thus neutralizing any motion that might be transmitted to the work by the belt. A 1 or 1½-hp. motor is mounted on a hinge plate at the back of the machine. Two belt speeds are obtainable from the V-belt drive. Drive to the feed rolls is by a V-belt, ¼-hp. motor. Maximum thickness through the feed rolls is 1 in. Adjustment for sanding strips of varying thickness is accomplished by mounting the upper belt unit adjustably in a bracket. Adjustment up to ½ in. is secured. Work from zero to ½ in. or ½ to 1 in. thick may be handled as required.



"Cimatool" Bevel-Gear Burring Machine

The City Machine & Tool Works, E. Third St. at June, Dayton, Ohio, has completed a large, special burring machine, which removes the burr thrown up in hobbing the bevel gear on automatic axle shafts. The machine is of the two-spindle type, each spindle being independent and allowing loading at one station while the other station is in operation. Although production time is regulated by the feed and varies somewhat with the amount of material to be removed, when utilized only on a burr-operation, the machine is capable of a six-second cycle.

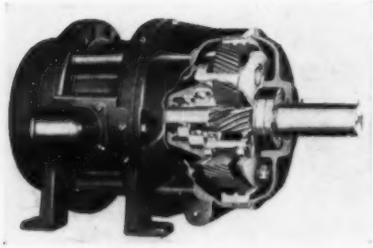
The machine is equipped with four motors operating the spindles, cam feed mechanism, and coolant and lubricating pumps. A self-oiling system is standard equipment. Through the arrangement of the hand clamping of the part, only a short travel of the clamping handle is necessary and at the same time non-slip action is secured.

"Day-Steel" Pulleys

The Dayton Rubber Mfg. Co., Dayton, Ohio, has announced a line of "Day-Steel" single and multiple V-groove pulleys for use with Dayton cog-belts for ratings of 7½ hp. and below. These pulleys are light in weight, and are accurately formed from heavy gage pressed steel welded both to the rim and at the web. They are assembled with a hub to give a balanced and true running pulley. Aluminum finish adds to the appearance of the pulley. Complete engineering and price data are given in Bulletin No. 110.

General Electric Gear-Motors

A line of gear-motors, readily adaptable for application to machinery of widely various designs, has been announced by the General Electric Co., Schenectady, N. Y. These gear-motors consist of a normal-speed motor in combination with a built-in, internal-helical, planetary gear speed reducer. This



type of construction permits a wide choice of speeds on the output shaft. The company also offers gear-motors with special electrical characteristics, such as: high starting torque with low starting current; normal starting torque with low starting current; adjustable, varying speed, multispeed, or other mechanical features such as totally inclosed; totally inclosed, fan-cooled; or Class I, Group D, construction. A.c., polyphase, squirrel-cage and wound-rotor gear-motors are available in ratings up to 75 hp., single phase to 5 hp., and d.c. to 7½ hp. Standard gear-motors can be had with shaft speeds down to 13 r.p.m.

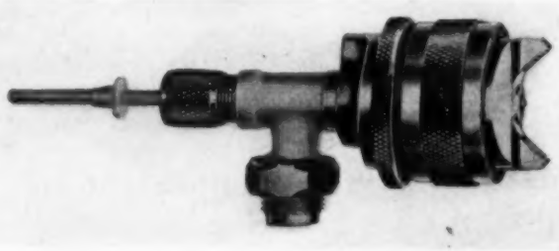
Reed-Prentice Sliding-Gear Head Toolroom Lathe

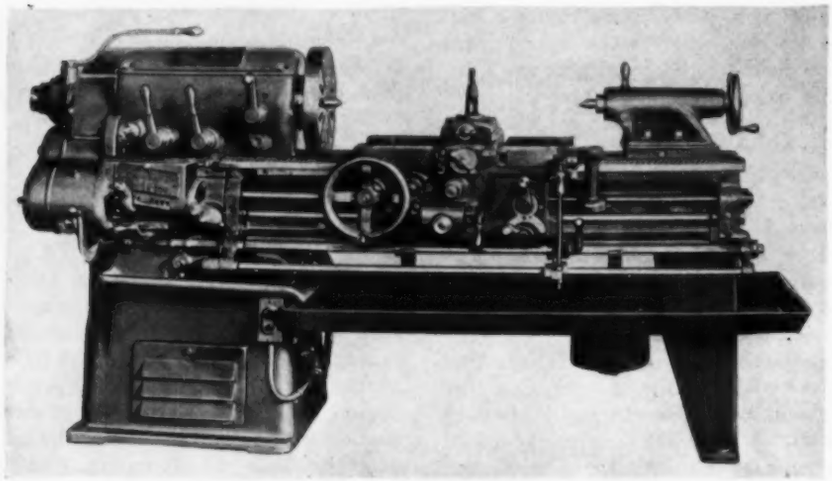
Sliding-gear head toolroom lathes are now available from the Reed-Prentice Corp., Worcester, Mass., in 8-and 16-speed, 14, 16, 18 and 20 in. sizes. Features now incorporated include: quick-change gearbox with leadscrew reverse mechanism, and an anti-friction end work. The quick-change gearbox provides 49 thread changes from 1½ to 96 and 49 feed changes from 0.0035 to 0.224 in. An auxiliary quadrant also provides for additional gears for odd or metric threads and feeds.

A leadscrew reverse mechanism provides for reversing the carriage when feeding or threading without reversing the direction of rotation of the spindle. The reverse lever is located at the right-hand side of the apron, and adjustable stops are fitted. When stopping the leadscrew and reversing, the leadscrew nut remains engaged, permitting ready catching of odd leads and metric pitches. Thread dials are provided for catching leads of long screws when the carriage is run back by hand. Other features are the same as those of the 8- and 16-speed lathes previously described.

DeVilbiss Spray Head for Porcelain Spraying

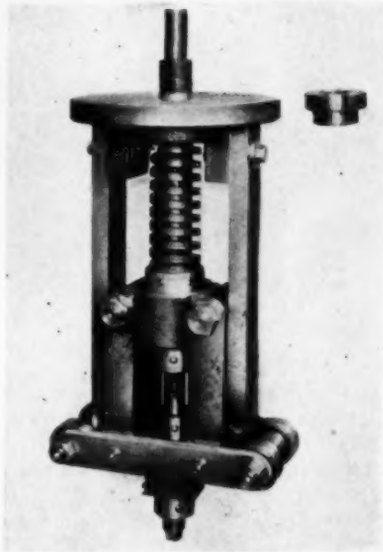
An assembly consisting of a spray head, air cap, fluid tip and fluid needle for the Type AV gun has been announced by the DeVilbiss Co., Toledo, Ohio, for the use of manufacturers who apply porcelain finishes to their products. The fluid tip and needle are of Nitralloy to provide protection against the abrasive action of vitreous materials. The assembly gives an even, soft and well-atomized spray about 9 in. wide when the gun is held 10 to 12 in. from the work. Several different nozzle sizes are available to provide for the requirements of the various types of porcelain finishing materials. A similar spray head assembly is offered to fit the Type B, P or WV spray guns.





"Simplex" Drawing Device

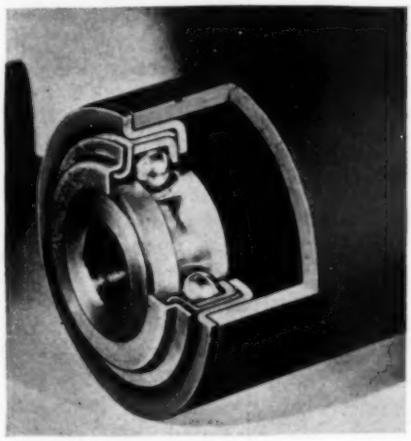
Attached underneath the bolster of a single-action press, the "Simplex" drawing device, developed by the Rockford Iron Works, Rockford, Ill., is said to permit production of deep-drawn stampings equal to those produced in a double-action press. The device requires no adjustment when changing from one die to another or from one gage of stock to another. The spring provided is solely for the purpose of returning the pressure plate and stripping the work.



The attachment operates on a balanced principle whereby only sufficient pressure is exerted on the blank to draw the shell. It employs a double rack and pinion. No special dies are required, and ordinary drawing dies or combinations may be used, but the center spindle of the device which rises when the draw ring is depressed. Pins beneath the pressure plates pass through the bolster and rest on the top plate of the Simplex, which is fitted with a rack on each side. These racks mesh their lower ends with pinions mounted on the device. These pinions co-act on a double center rack attached to the spindle on which the center block is mounted, and as the draw ring is depressed the center block moves upward at the same relative speed, thus balancing the pressure on the draw ring and the center block. The device is made in eight sizes, the smallest of which is for a maximum depth of draw of 3 in., and the largest a depth of draw of 6 in.

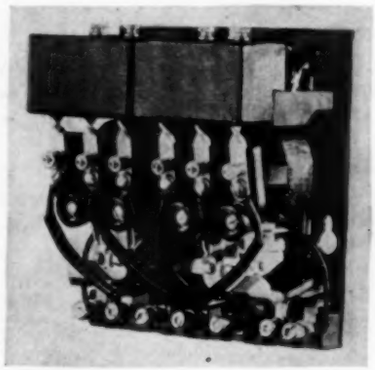
Logan Dust-Proof Ball Bearings

Labyrinth construction of its patented ball bearings for roller conveyor applications is claimed by the Logan Company, Louisville, Ky., to prevent entrance of dust particles. The bearing is made in light, medium and heavy sizes. The dust shield does not come in contact with the shaft to increase friction or develop wear.



Square D Class 7711 and 8711 Contactors

A three-pole reversing magnetic contactor, interchangeable in rating and dimensions for a.c. and d.c. currents, has been developed by the Industrial Controller Division, Square D Co., Milwaukee, Wis. Maximum rating is 3 hp. The unit is adaptable for hoists, reversing machine tools and similar applications. The contactors have a positive mechanical interlock and magnetic safety latches to prevent accidental closing. They are arranged for either two-wire or three-wire control. Edgewise mounting of the movable contacts and the form of arc suppressors constitute a new principle of design for increasing the arc rupturing capacity. For a.c., the contactor is designated as Class 8711; for d.c., Class 7711.

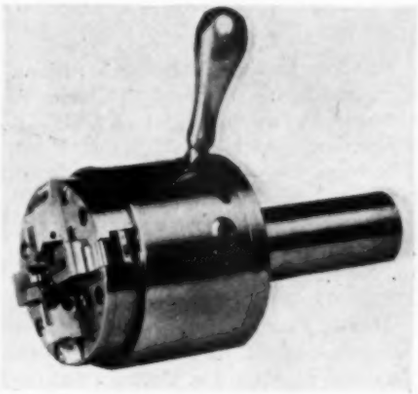


Greenfield Stub Taps with Square Shanks

The Greenfield Tap & Die Corp., Greenfield, Mass., has announced that it will henceforth supply its "Stub" taps with a square on the end instead of with a plain round shank to make the taps available for use in all automatic tapping machines. It is said that this will not prevent their effective use in machines which are equipped with chucks or collets for plain round shank taps. There will be no change in price. Stub taps are supplied in machine screw sizes.

"H & G" Style MS Insert Chaser Diehead

Intended for hand turret lathes and similar machines where the diehead does not rotate, the Style MS insert chaser diehead has been announced by the Eastern Machine Screw Corp., Truman & Barclay Sts., New Haven, Conn. This head uses the same insert chaser as used in the rotary head made by the company. The advantage of the tool is that time out is not required for sharpening chasers. The chasers always project beyond the body for the same amount.



The head is of the pull-off type. Chasers can be changed in two minutes. The head is so designed that if the part threaded should come loose in the collet or chuck, the head may be tripped by a slight blow on the closing handle. An adjustable work stop may be fastened in the shank to trip the head by contact with the work. The diehead is made in four different numbers, the first having a diameter range of $\frac{1}{8}$ to $\frac{1}{2}$ in., and the last from $1\frac{5}{32}$ to 3 in.

• TRADE •

PUBLICATIONS

BEARING BRONZE. The U. S. Department of Commerce, Bureau of Standards, has issued Research Paper No. 442, entitled, "Effect of Antimony on the Mechanical Properties of a Bearing Bronze (Cu 80 : Sn 10 : Pb 10)." The bulletin is for sale by the Superintendent of Documents, Washington, D. C., but the price is not mentioned.

COUNTERBORES. Catalog CT-132 on "Continental" interchangeable counterbores has been published by Ex-Cell-O Aircraft & Tool Corp., 1200 Oakman Blvd., Detroit, Mich. The catalog features all types of interchangeable counterbores, core drills, inverted spot facers and special tools.

FITTINGS FOR WELDINGS. The "Taylor Forge" just issued by Taylor Forge & Pipe Works, P. O. Box. 485, Chicago, Ill., illustrates fabrication of welded pipe lines, using the company's standard fittings.

GEAR INSPECTION APPARATUS. Fellows Gear Shaper Co., Springfield, Vt., has printed a new edition of its booklet "The Red Liner," describing an automatic machine for inspecting gears under conditions approaching those of actual operation. The new edition contains amplified material and also information on the inspection of spur, helical, internal and face gears.

LUBRICATION OF CYLINDRICAL BEARINGS. Stanford University Press, Stanford University, Calif., has published No. 1, Vol. 1, of a series of engineering bulletins entitled, "Some Experiments on Oil Films in Complete Cylindrical Bearings," by Guido H. Marx. The bulletin contains 110 pages, 101 figures, and is sent postpaid, paper binding, for $1.00, and cloth binding, $1.50.

MAGNETIC CLUTCHES. Dings Magnetic Separator Co., Milwaukee, Wis., has prepared a 16-page bulletin on the installation and use of magnetic clutches for special and general power transmission applications. The bulletin describes three types of clutches—single disk, multiple disk, and serrated disk. Tables of performance data are also included.

MANUFACTURERS OF STEEL CASTINGS. Under the auspices of the Steel Founders' Society of America, Inc., 932

Graybar Bldg., 420 Lexington Ave., New York, N. Y., there has been published a 1932-1933 "Directory of Manufacturers for Steel Castings, and Heat-Corrosion Resistant Alloy Castings in the United States and Canada," with statistical information on the steel and alloy foundry industries. The directory is sold for $10.00.

MOTORS. Lincoln Electric Co., Cleveland, Ohio, has issued a folder on its "Linc-Weld" Type E induction motor of the totally inclosed, fan-cooled type. The motor is housed in stainless steel inclosures.

MOTORS. Reliance Electric & Engineering Co., Ivanhoe Road, Cleveland, Ohio, has issued Bulletin 112, as of May, 1932, on fully-inclosed fan-cooled induction motors—Type AA, Form F. Several details of the construction are described and illustrated.

REVERE CATALOG. Revere Copper & Brass, Inc., 230 Park Ave., New York, N. Y., has mailed its July 1st semi-annual catalog, which is now published in 8½x11-in. size. The catalog is a completely bound book, and complete information regarding any one product is found on two facing pages for quick reference.

RYERSON STOCK LIST. A new issue of the "Ryerson Journal and Stock List" which is a reference book on steel, in addition to complete general descriptions, specifications, and sizes, together with extras, is now available from Joseph T. Ryerson & Son, Inc., 16th & Rockwell Sts., Chicago, Ill.

SHAFTS. An engineering bulletin of Purdue University, Lafayette, Ind., and known as Research Series No. 39, is entitled "Bibliography of the Vibration of Shafts" and "Vibration Measurements and the Design of Crankshafts." The publication contains 109 9x6-in. pages. Price, $1.00.

SCREW THREAD, SELF-LOCKING. Bulletin No. 5, issued by Dardelet Threadlock Corp., 120 Broadway, New York, N. Y., is the third edition of its booklet "Dardelet Self-Locking Screw Thread." In this edition there is complete information on the thread characteristics as well as new information and illustrations of applications in various lines of equipment.

SMALL TOOLS. Catalog No. 32 is being distributed by Greenfield Tap & Die Corporation, Greenfield, Mass., and describes the entire line of taps, dies, screw plates, twist drills, reamers, gages, and pipe tools, together with miscellaneous items. Included there are a number of tables and data on the uses and application of small tools. The catalog contains 384 pages and is printed throughout in color.

SPECTROGRAPHIC ANALYSIS. Bausch & Lomb Optical Co., Rochester, N. Y., now has available a very effective bulletin entitled "Instruments for Spectrographic Analysis," which gives general information on the instruments necessary, together with accessories, and also provides descriptions and prices of Bausch & Lomb instruments.

STRUCTURAL ALUMINUM HANDBOOK. A supplement to its "Structural Aluminum Handbook" is now available from Aluminum Co. of America, Pittsburgh, Pa. The supplement contains additions to the tables, as well as new data which were not available at the time the handbook was published.

THREADING MACHINERY. Landis Machine Co., Inc., Waynesboro, Pa., is now distributing a folder containing several bulletins on its threading machinery, such as the "Landmaco" threading machine, standard threading machines, and automatic forming and threading machines.

• PATENTS •

JUNE 28, 1932

Metal-Working Machinery

Grinding Machine. George W. Binns, Cincinnati, Ohio, assigned to Cincinnati Grinders Incorporated. Patent 1,864,578.

Grinding Machinery. Hans Ernst, Cincinnati, Ohio, assigned to Cincinnati Grinders Incordorated. Patent 1,864,589.

Grinding Machine. Franz Warsow, Pankow, near Berlin, Germany, assigned to the Heald Machine Co. Patent 1,865,067.

Milling Machine. Newman M. Marsilius, Bridgeport, Conn., assigned to the Producto Machine Co. Patent 1,865,198.

Screw Machine for Cutting Single-Point Double-Thread Screws. John A. Arenz, Mount Vernon, N. Y., assigned to International Screw Co. Patent 1,865,226.

Drilling Machine. Edward Joslin Kingsbury, Keene, N. H. Patent 1,865,375.

Tools and Attachments

Gear Cutting Tool. Leon D. Slade, Rochester, N. Y., assigned to Gleason Works. Patent 1,865,148.

Lapping Device. Conrad F. Birgbrauer, Detroit, Mich. Patent 1,865,229.

Processes

Method and Mechanism for Grinding Rods. Robert H. Cowdery, Geneva, Ohio, assigned to The American Fork & Hoe Co. Patent 1,864,584.

Process of Preparing Wearing Surfaces for Tools, Dies and the Like, and Resultant Product. Albert F. Fifield, St. Catharines, Ontario, Canada, assigned to The American Fork & Hoe Co. Patent 1,864,590.

Method of Form Grinding. Walter L. Hutchinson, Hartford, Conn., and Robert F. Runge, Forest Hills Gardens, N. Y., assigned to The Skayef Ball Bearing Co. Patent 1,865,392.

JULY 5, 1932

Metal-Working Machinery

Machine Tool. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,865,527.

Machine Tool. John E. Lovely, Springfield, Vt., assigned to Jones & Lamson Machine Co. Patent 1,865,528.

Welding Machine. George A. Lutz, Cranford, N. J., assigned to American Circular Loom Co., Inc. Patent 1,865,532.

Drilling Machine. Joseph E. Horste, Detroit, Mich., assigned to Detroit Harvester Co. Patent 1,865,567.

Die-Casting Machine. William J. During, Syracuse, N. Y., assigned to Precision Castings Co., Inc. Patent 1,866,191.

Grinding Machine. George T. Huxford and Frank E. Stratton, Providence, R. I., assigned to Builders Iron Foundry. Patent 1,866,212.

Machine Tool. Edward J. Kearney, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,866,259.

Milling Machine. Walter Ferris, Milwaukee, Wis., assigned to the Oilgear Co. Patent 1,866,348.

Tools and Attachments

Metal Cutting Tool. Frank W. Curtis, Wauwatosa, Wis., assigned to Kearney & Trecker Corp. Patent 1,865,617.

Processes

Method of and Means for Welding. George A. Lutz, Cranford, N. J., assigned to American Circular Loom Co., Inc. Patent 1,865,529.

Means for Lap-Welding. George A. Lutz, Cranford, N. J., assigned to American Circular Loom Co., Inc. Patent 1,865,531.

Method of Flash Welding Tubular Articles. Warren F. Heineman, Shorewood, Wis., assigned to A. O. Smith Corp. Patent 1,866,256.